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THE
GEOGRAPHICAL REVIEW

VOL. XIII JANUARY, 1923 No. 1

LAND UTILIZATION IN THE UNITED STATES: GEOGRAPHICAL ASPECTS OF THE PROBLEM*

By O. E. BAKER
U. S. Department of Agriculture

The use made of the land by the people, or the use which should be made, constitutes the field of land utilization. In its agricultural aspects and with reference to the United States, this subject includes not only the extent, character, and productiveness of the arable and non-arable land, but also the present and prospective food, fiber, and forest-product requirements of our people. The subject, in other words, has two sides, a geographic and a demographic. The geographic side consists largely of a survey of the temperature, moisture, topography, and soil conditions which influence the utilization of land for crops, pasture, or forest; and includes also the location of the land with reference to markets for agricultural or forest products. The demographic side involves studies of population distribution and its trend both in this and other countries; the present and probable future demand, both domestic and foreign, for food and other agricultural products; and the proportion of the people engaged in farming and forestry, now and in prospect.

A TRANSITION PERIOD IN AMERICAN AGRICULTURE

The problems involved in this relationship of the people to the land are especially pressing today, because we are at a turning point in our national history. We have reached the stage in our agricultural development when there is practically no more potential agricultural land left unutilized that does not involve unprofitable expense for reclamation or clearing. Much of our agricultural land could be cultivated more intensively, however, when higher prices for agricultural commodities justify the increased costs of production.

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* Read at the Joint Meeting of the Association of American Geographers and the American Geographical Society, April, 1922.

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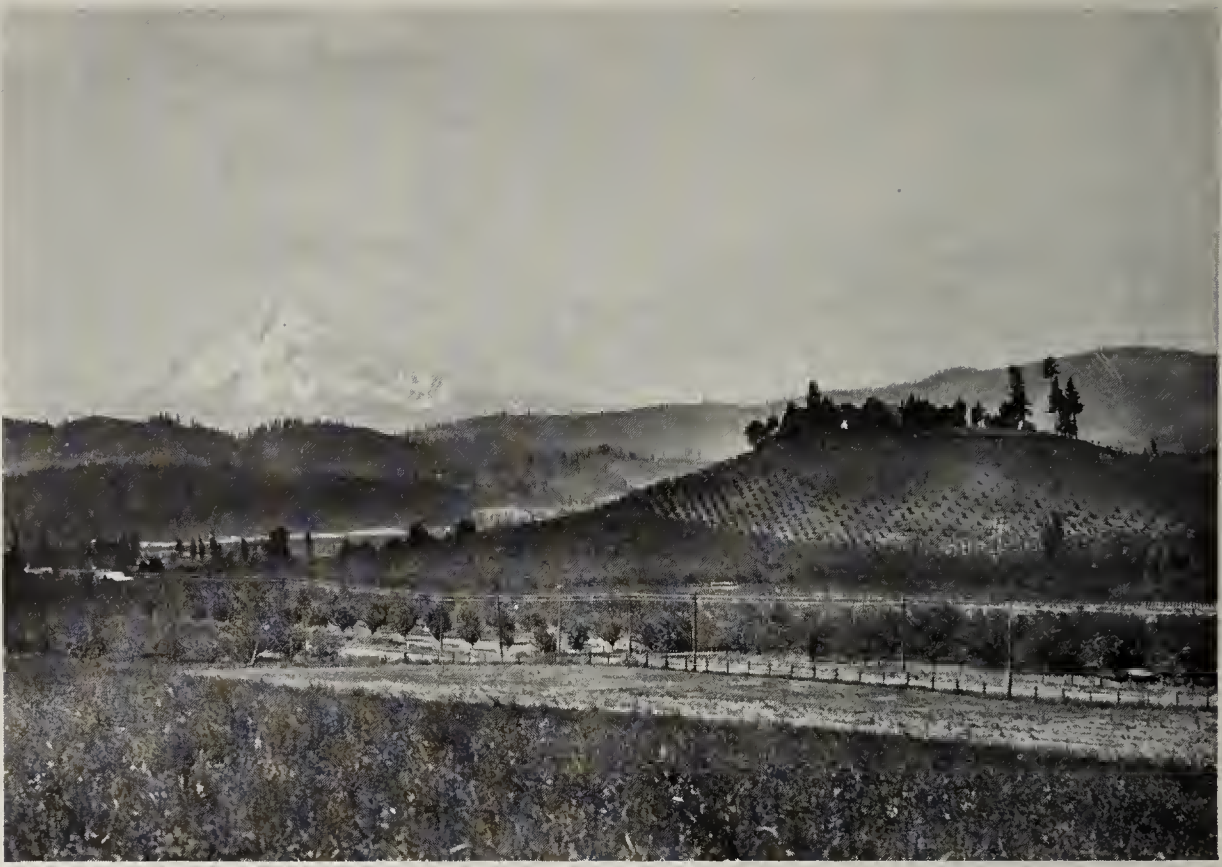

Fig. 1

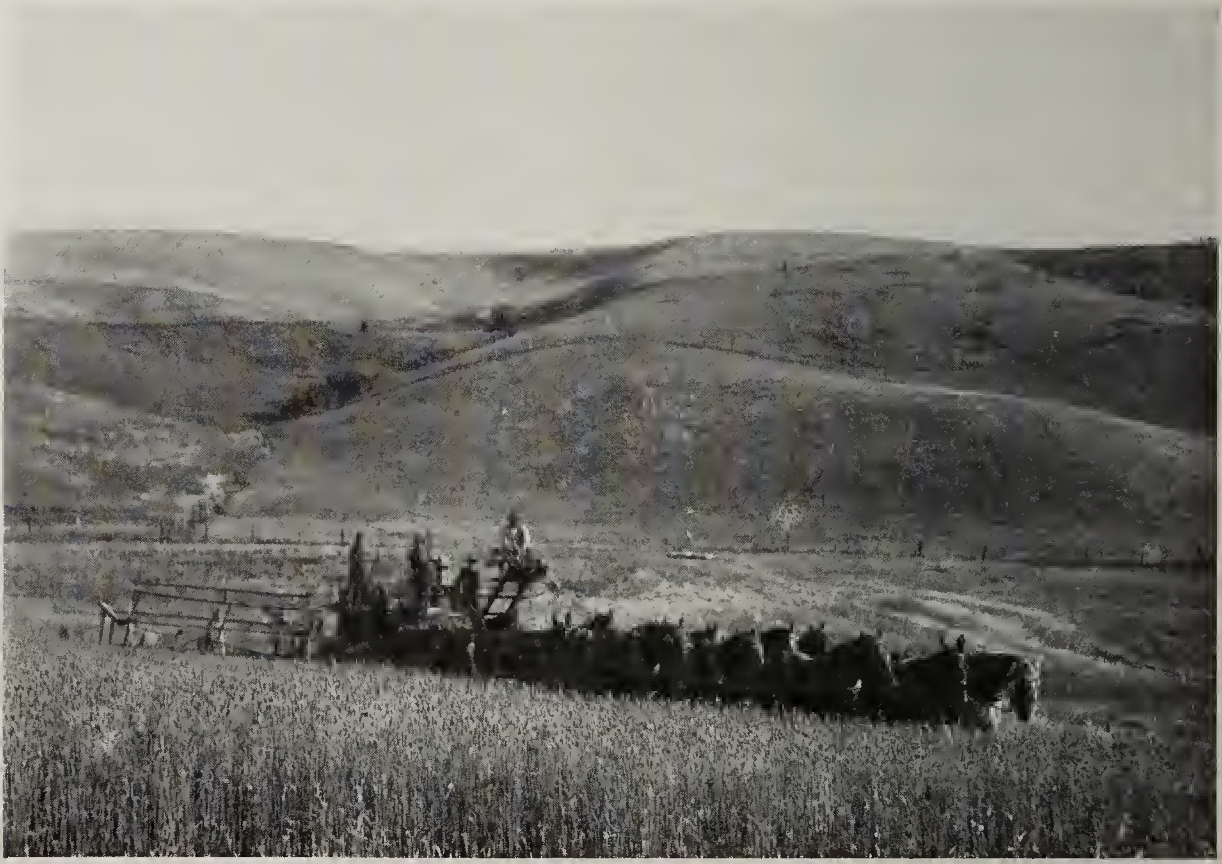

Fig. 2

Fig. 1—Mt. Hood from the Hood River Valley. The utilization of land as determined by topographic conditions. The level bottom lands are used for crops and the hill slopes for pasture or fruit; the mountains are covered with forest, except the peaks above timber line. (Photograph by S. M. Thomson. All photographs used to illustrate this article are from the Bureau of Agricultural Economics, U. S. Department of Agriculture.)

Fig. 2—The most steeply rolling land in the United States used for crops planted and harvested by modern machinery is to be found, probably, in the Palouse country of eastern Washington, where this picture was taken. Still steeper slopes are planted to corn and other crops in parts of the southern Appalachians where hand methods of culture persist. (Photograph by Earl D. Strait.)

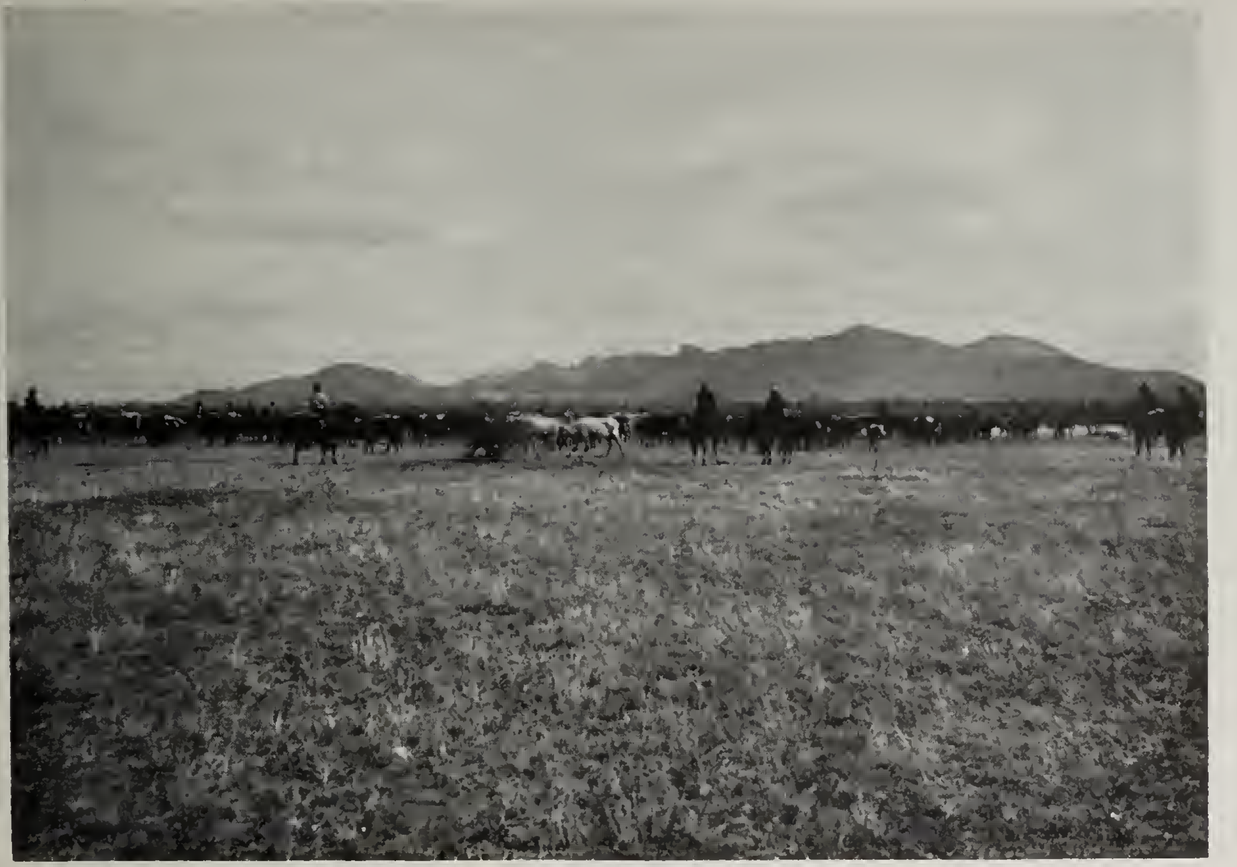

FIG. 3

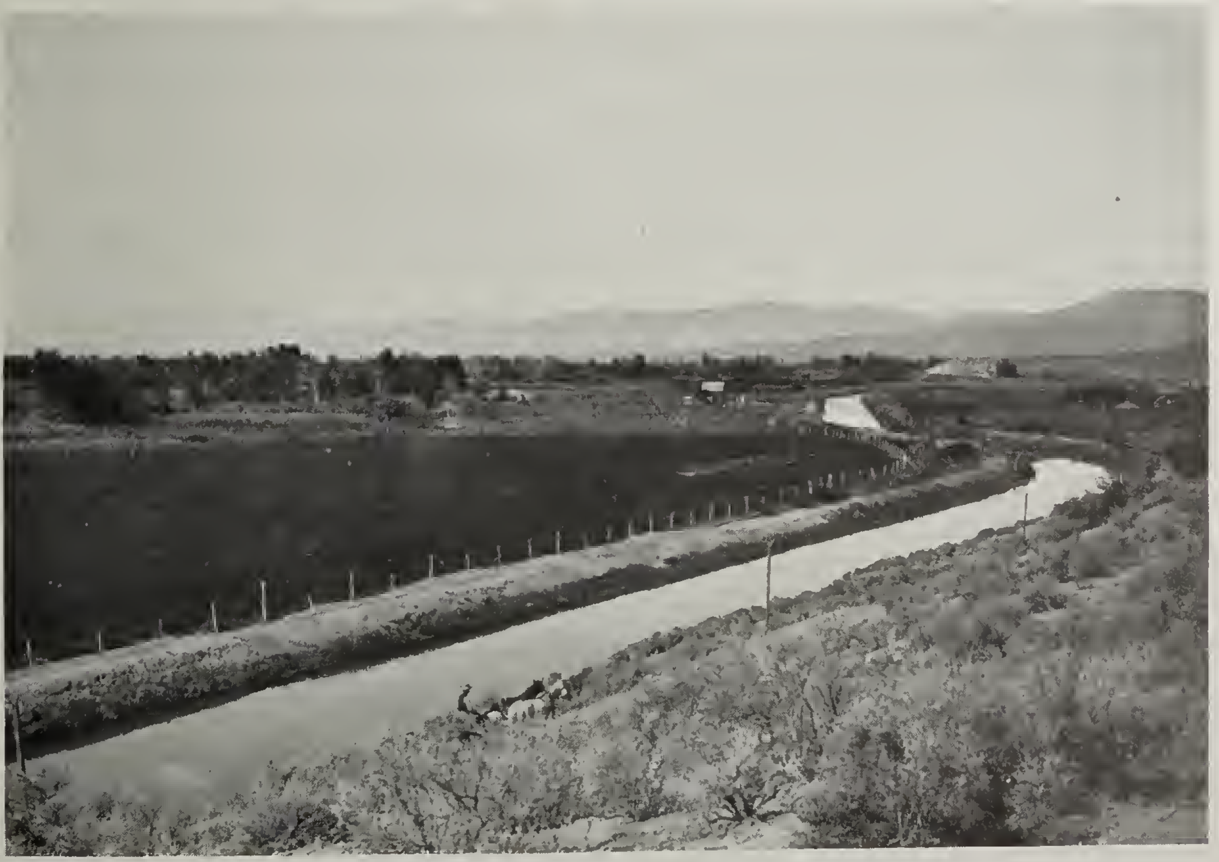

FIG. 4

FIG. 3—A round-up on short-grass range land near the Santa Rita Mountains in southeastern Arizona. There are 650 million acres in the West too dry for crop production. There is enough water to irrigate only about eight per cent of this arid area: the rest must always remain grazing or desert land. (Photograph by David Griffiths.)

FIG. 4—Sunnyside Canal, Yakima Valley, Wash., showing typical contrast between the gray sagebrush desert above the irrigation ditch and the green alfalfa fields below. (Photograph by F. Lamson-Scribner.)

The country has been settled; it is now being resettled. Certain pasture lands are being broken and some forest lands cleared for crops, while other hilly or sandy lands, formerly used for crops, are being allowed to revert to pasture or forest. Some people are leaving the land and moving to the cities, while others are taking their places on the land. Moreover, we have entered the economic arena of the world. Our exports of agricultural products are greater than ever before, but in a few years our imports may exceed our exports. It is a transition time, and our agricultural situation is uncertain. The decision our nation will soon be compelled to make with reference to land policies will affect not only our agricultural progress but also our national welfare for a century to come.

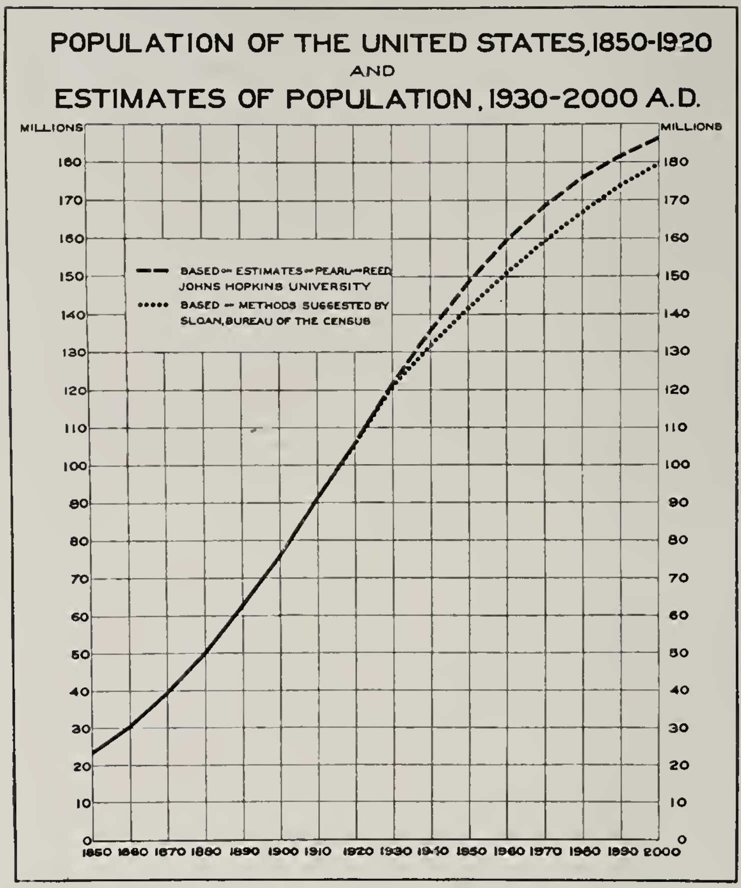

FIG. 5—Graph showing population trend of the United States.

CULTIVATED LAND INCREASING SLOWLY, POPULATION RAPIDLY

The land area of the United States is limited, and our arable land is still more limited. Because of climatic or topographic conditions, only about 40 per cent of our land area can ever be used for crops, and most of this arable land is already so used. On the other hand, our population is inherently unlimited and is increasing at the rate of a million and a half a year. During the nineteenth century the population of the United States increased from five millions to 76 millions, or fifteen-fold, and during the first twenty years of the twentieth century the increase has been 40 per cent of the increase during the preceding century. The rate of increase, however, has declined. From the Revolutionary War to the Civil War the increase was at the almost uniform rate of 35 per cent each decade; from 1870 to 1880 population increased 30 per cent; from 1880 to 1890, 25 per cent; from 1890 to 1910, 20 per cent; and from 1910 to 1920, 15 per cent. Should even this low rate of increase during the past decade, which included the World War and several epidemics of influenza and also six years without immigration, continue, our country would have in about a century a population equal to that of China today.

However, if the population estimates of Dr. Pearl and Dr. Reed, of Johns Hopkins University, made on the basis of certain mathematical and biological deductions, are accepted, this rate of increase will not continue but will gradually diminish so that by 1950 our population will be only about 150 millions and by the end of the twentieth century will reach an almost stationary state, like that of France today, at 185 to 190 millions. A somewhat less refined method of calculation suggested by Dr. Sloane, of the Bureau of the Census, works out to a similar result of about 175 millions in the year 2000 (Fig. 5). These estimates of 175 to 185 millions of people in 2000 A.D. are, of course, subject to the vicissitudes of time; but the estimate of 145 to 150 millions in 1950, a year that many of us are likely to live to see, is reasonably safe. How to feed, clothe, house, and provide with the amenities of modern life these forty additional millions of people is the immediate problem confronting the American nation.

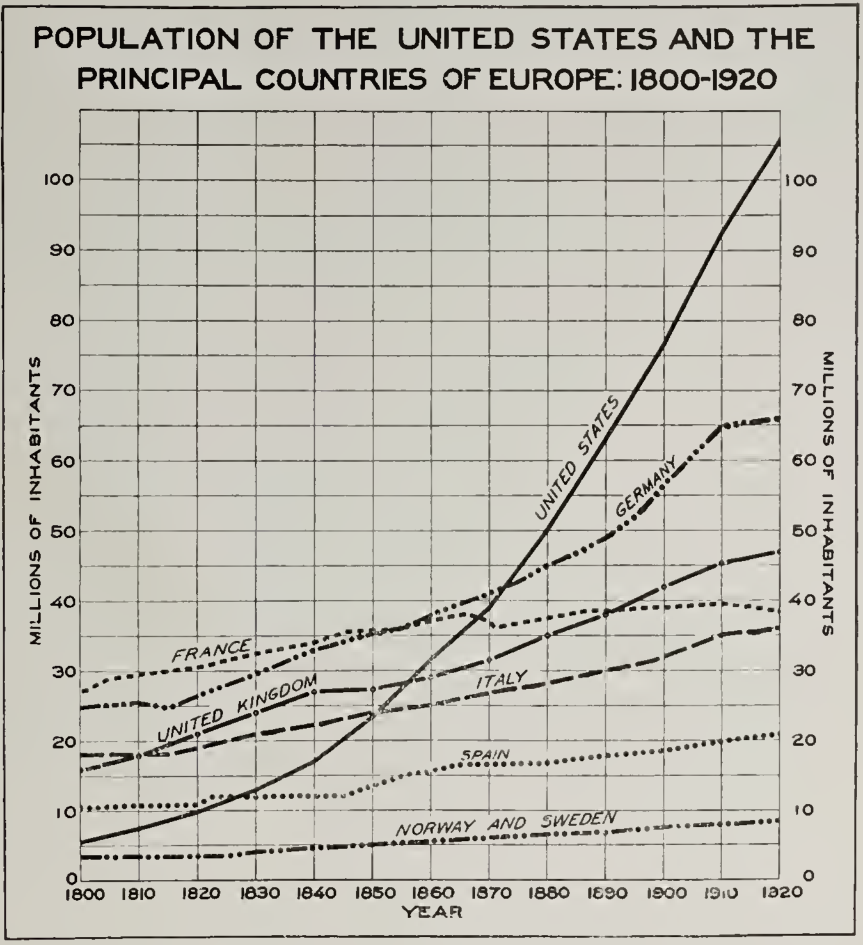

FIG. 6—Graph comparing twelve decades' growth of population in the United States and principal European countries. The graph is adapted from a figure in the 1910 Census, Vol. 1, p. 35; estimates are from the Statesman's Yearbook.

Although this is a new problem to us it is an old problem in the Old World. France has found a temporary solution, at least, in limitation of population; England, in industrial development and the exchange of manufactured goods for food and raw materials from other lands; while Germany has followed England's example and also, in greater degree than France or England, has achieved notable increase in the productiveness of the land. Recently these three nations have tried the old remedy of retarding population growth by war, while Russia has added to the horrors of war the even more effective method of famine (Fig. 6). He who surveys the Old World, whether he look at Europe, Asia, or Africa, will see dominating the entire

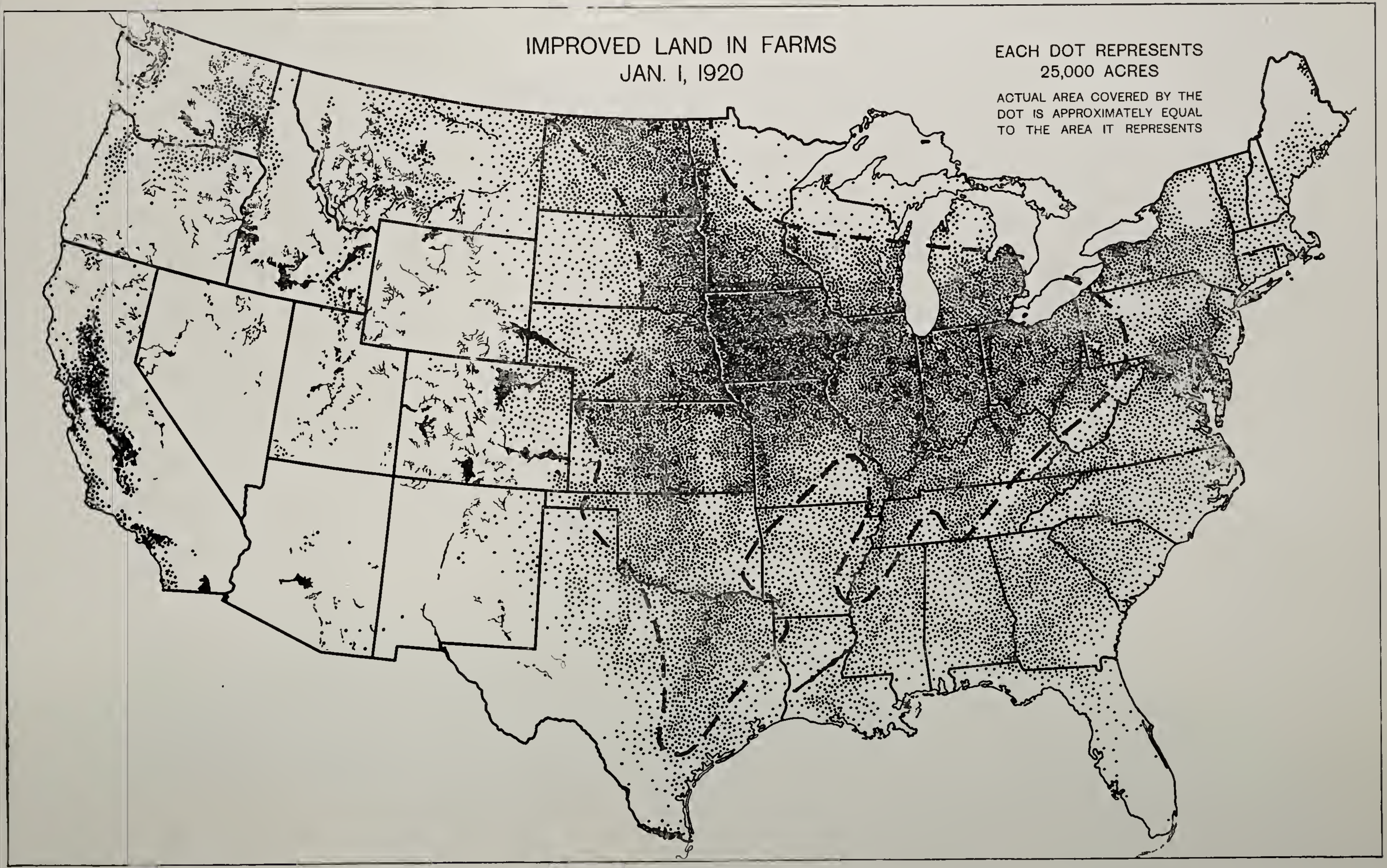
IMPROVED LAND IN FARMS
JAN. I, 1920
EACH DOT REPRESENTS
25,000 ACRES
ACTUAL AREA COVERED BY THE
DOT IS APPROXIMATELY EQUAL
TO THE AREA IT REPRESENTS

FIG. 7—Improved land in the United States now amounts to a little over one-fourth of the total land area (compare Table I). Four-fifths of it is in the humid eastern half of the United States, and three-fifths is concentrated in the triangular-shaped area indicated by the heavy broken line. In this area 60 per cent of the land area is improved farm land, whereas in the United States outside this area only 15 per cent is improved. Note the irrigated land in the West and compare with Table III.

TABLE I—IMPROVED LAND IN FARMS AND LAND IN HARVESTED CROPS, 1919–20

STATE	IMPROVED LAND		LAND IN HARVESTED CROPS	
	ACRES	PER CENT	ACRES	PER CENT
Tex.	31,227,503	18.6	25,534,195	15.2
Kan.	30,600,760	58.5	22,843,587	43.6
Ia.	28,606,951	80.4	21,609,534	60.7
Ill.	27,294,533	76.1	21,462,852	59.9
Mo.	24,832,966	56.5	16,810,354	38.2
N. Dak.	24,563,178	54.7	19,760,741	44.0
Neb.	23,109,624	47.0	19,432,145	39.5
Minn.	21,481,710	41.5	17,149,813	33.1
Ohio	18,542,353	71.1	13,934,239	53.4
S. Dak.	18,199,250	37.0	15,313,006	31.1
Okla.	18,125,321	40.8	15,393,796	34.7
Ind.	16,680,212	72.3	13,223,256	57.3
Ky.	13,975,746	54.3	7,532,641	29.3
N. Y.	13,158,781	43.1	8,904,768	29.2
Ga.	13,055,209	34.7	12,537,645	33.4
Mich.	12,925,521	35.1	10,000,611	27.2
Wis.	12,452,216	35.2	10,265,998	29.0
Cal.	11,878,339	11.9	6,850,805	6.9
Pa.	11,847,719	41.3	8,999,116	31.4
Tenn.	11,185,302	41.9	7,430,888	27.9
Mont.	11,007,278	11.8	3,924,337	4.2
Ala.	9,893,407	30.1	8,091,496	24.7
Va.	9,460,492	36.7	5,819,414	22.6
Miss.	9,325,677	31.4	6,603,052	22.3
Ark.	9,210,556	27.4	6,839,300	20.3
N. C.	8,198,409	26.3	6,625,009	21.2
Colo.	7,744,757	11.7	5,416,712	8.2
Wash.	7,129,343	16.7	4,251,170	9.9
S. C.	6,184 159	31.7	5,852,376	30.0
La.	5,626,226	19.4	4,022,658	13.8
W. Va.	5.520,308	35.9	2,295,905	14.9
Ore.	4,913,851	8.0	2,993,388	4.9
Ida.	4,511,680	8.5	2,797,943	5.2
Md.	3,136,728	49.3	2,303,282	36.2
Fla.	2,297,271	6.5	1,829,864	5.2
Wyo.	2,102,005	3.4	1,210,250	1.9
Me.	1,977,329	10.3	1,650,189	8.6
N. Mex.	1,717,224	2.2	1,197,752	1.5
Utah	1,715,380	3.3	1,071,160	2.0
Vt.	1,691,595	29.0	1,192,876	20.4
N. J.	1,555,607	32.4	1,162,480	24.2
Mass.	908,834	17.7	664,043	12.9
Ariz.	712,803	1.0	471,345	.6
N. H.	702,902	12.2	548,124	9.5
Conn.	701,086	22.7	519,521	16.8
Del.	653,052	51.9	616,865	49.1
Nev.	594,741	.8	392,520	.6
R. I.	132,855	19.5	76,197	11.2
Total	503,073,007	26.4	375,431,734	19.7

economic and social situation this great problem of food supply and of efficient utilization of the land.[1]

Agricultural Maturity in the United States

Now the New World, especially the United States, is attaining maturity. We have extended the area of our cultivated land as far as economic conditions justify (Fig. 7 and Table I). We have nearly cleaned up the original 800 million acres of virgin timber (16 per cent only remains in virgin forest and 30 per cent in second growth) and are confronted with the necessity of growing a new supply. How are we to feed, clothe, and house the oncoming millions? Shall we follow in the footsteps of France and limit our population? or shall we emulate England, encourage industry, and depend in large measure upon foreign lands for our food and raw materials? or shall we endeavor to remain a self-sufficing nation, as Germany tried to become, and embark upon a national policy of land reclamation and fertilization? Apparently the people of the United States are essaying, unconsciously in large measure, all three solutions of the problem. The birth rate is declining, notably and dangerously among the middle and upper classes; industry has increased rapidly, so that since the war our exports of manufactured products have equaled in value those from Great Britain; and we have also, in the Reclamation Act of 1902, established a precedent for federal subsidy in expanding the agricultural area, while in the Muscle Shoals project it appears likely that similar encouragement will be extended in the manufacture of fertilizer. The justification of the Reclamation Act, if such is needed, and of the Muscle Shoals decision, when it is made, is to be found, not in the balance sheet of profit and loss, but in promotion of the public welfare. Such subsidies were incompatible with the classical political economy of England and were not given; but the United States, like Germany, has long afforded both her agricultural and industrial inter-

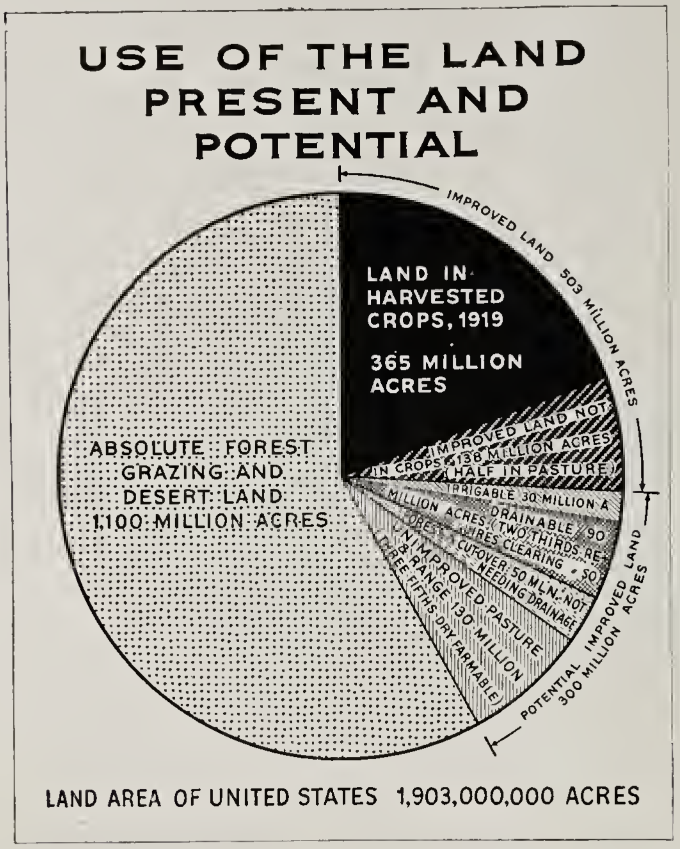

Fig. 8

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[1] Cf. the article by Raymond Pearl: The Population Problem, *Geogr. Rev.*, Vol. 12, 1922, pp. 636–645.

ests the protection of a high tariff. This protection, and possibly direct financial assistance, such as that afforded by the Reclamation Act, may be extended if Congress deems it necessary that we remain a self-sufficing nation and desires to assure the expansion of our agricultural area at a rate sufficient to provide for the increasing population.

Increase in Agricultural Production through Reclamation

We still have about 300 million acres, an amount three-fifths of the present acreage of improved land, which it is possible by various means of amelioration to bring into use for crops. This area, mostly scattered in small tracts in various parts of the United States, consists of about 30 million acres of irrigable land and probably 90 million acres of drainable land, which can be reclaimed when the price of farm products justifies the cost; also there are perhaps 50 million acres of forest and cut-over lands, not requiring drainage but in many cases deficient in fertility, which may be used for crops after clearing; and about 130 million acres of stony or infertile pasture land in the East and potential dry-farming land in the West, the use of which for crops is not justifiable at present prices of agricultural products and labor (Fig. 8).

A national policy with regard to these 300 million acres which could, by expenditure of large sums of money, be made available for crops, is complicated by the consideration that it may be more profitable to increase the productivity of the lands already in use and by the probability that with the return to normal conditions in the Old World, and especially with the development of agriculture in the tropics, certain foods, particularly sugar and the vegetable oils, will be imported from abroad more cheaply than they can be produced at home. The question has been raised whether a reclamation policy must not be fortified by an agricultural tariff policy. It is a pertinent question and one deserving careful study.

But first let us consider whether we can provide from our own lands for the 40 millions more people in 1950, and then for still 40 millions more by the year 2000, with the same amount per capita of agricultural products that are consumed today.

To begin with, our net exports of farm products during the three years since the war have required for their production about one-eighth of our agricultural land. In other words, we are consuming about seven-eighths of our agricultural production; consequently, were our exports to cease we could provide about 125 million people with the same per capita amounts of agricultural products that are consumed at present. Next, with reference to the 30 million acres of irrigable land yet unirrigated, assume that these will be one-third more productive than our improved land is at present. The irrigable area would then be equivalent to 40 million acres of average improved land and would constitute an eight per cent increase upon our 500 million acres of improved land in the year 1920 (Table II). Next, the drainable land, although it includes large amounts of very fertile land along the Mississippi River, also includes even larger amounts of sandy or peaty soil in Florida and along the South Atlantic coast, and much peat land also in the Lake states, and consequently is unlikely to be more productive than the average of our improved land at present (Fig. 9 and Table III). Ninety million acres is 18 per cent of the 500 million acres of improved land in 1920. The reclamation of most of this land will require co-operative effort. Fully two-thirds of the drainable land will require clearing also.

We come now to the two kinds of land which can be made available for crops by private effort—(1) forest and cut-over land not needing drainage and (2) pasture or grazing land. The forest and cut-over land is mostly poor soil and without heavy fertilization probably would not yield over two-thirds as much per acre as our present improved land. The agricultural production from the 50 million acres of forest and cut-over land would be equivalent, therefore, to that of only 33 million acres of average improved land, or seven per cent of our present acreage. However, in all probability forests will be found to afford a more profitable use for much of this land

TABLE II—IRRIGATED AND IRRIGABLE LAND, 1919 AND 1920*

(In acres)

STATE	AREA IRRIGATED 1919	AREA ENTERPRISES CAPABLE OF IRRIGATING	AREA IN ENTERPRISES 1920	TOTAL IRRIGABLE AREA
Cal.	4,219,040	5,894,466	7,805,207	10,000,000
Colo.	3,348,385	3,855,348	5,220,588	5,000,000
Ida.	2,488,806	3,092,810	3,780,048	5,500,000
Mont.	1,681,729	2,753,498	4,329,148	6,000,000
Utah	1,371,651	1,700,550	2,359,244	2,500,000
Wyo.	1,207,982	1,831,039	2,564,668	4,000,000
Ore.	986,162	1,344,046	1,925,987	3,000,000
Tex.	586,120	1,150,542	1,687,447	3,000,000
Nev.	561,447	704,708	1,382,036	1,500,000
N. Mex.	538,377	696,119	961,879	2,000,000
Wash.	529,899	637,151	836,795	3,000,000
Ariz.	467,565	627,303	813,153	1,000,000
La.	454,882	728,742	851,211	....
Neb.	442,690	562,468	766,768	1,000,000
Ark.	143,946	179,013	246,480	....
S. Dak.	100,682	150,914	188,382	1,000,000
Kan.	47,312	67,853	102,562	500,000
N. Dak.	12,072	34,235	57,476	1,500,000
Okla.	2,969	9,672	11,742	500,000
U. S.	19,191,716	26,020,477	35,890,821	51,000,000

* Estimates compiled by Dr. R. P. Teele, U. S. Department of Agriculture.

than crops, so that we cannot safely count on increasing our agricultural production more than five per cent by the further clearing of forest and cut-over land not needing drainage (Fig. 10).

Lastly, we have to consider the upland pastures in the East and the potential dry-farming land in the West, perhaps some 130 million acres in all of land that might be used for crops if prices of agricultural products, particularly hay and wheat, were much higher than at present (Fig. 11). The average productivity of this land could not be rated at more than three-fifths that of our present improved land, so that it would be equivalent to only 80 million acres, or 16 per cent of the present improved acreage.

Adding together these estimates of 8 per cent increase in production when all our irrigable land is irrigated, 18 per cent when all the drainable land is drained, 5 per cent when all the forest and cut-over land is cleared

TABLE III—WET, SWAMP, AND OVERFLOWED LANDS IN NEED OF DRAINAGE, 1920*

(In acres)

State	Unfit for Cultivation without Drainage	Needing Community Drainage	State	Unfit for Cultivation without Drainage	Needing Community Drainage
Ala.	2,664,000	3,227,000	Neb.	91,000	586,000
Ariz.	23,000	41,000	Nev.	53,000	135,000
Ark.	4,220,000	4,881,000	N. H.	119,000	125,000
Cal.	1,179,000	1,861,000	N. J.	52,000	655,000
Colo.	66,000	132,000	N. Mex.	26,000	61,000
Conn.	111,000	127,000	N. Y.	815,000	1,091,000
Del.	188,000	251,000	N. C.	5,390,000	5,886,000
Fla.	16,846,000	16,914,000	N. Dak.	137,000	953,000
Ga.	6,876,000	7,431,000	Ohio	269,000	650,000
Ida.	97,000	141,000	Okla.	650,000	952,000
Ill.	600,000	2,340,000	Ore.	650,000	2,790,000
Ind.	778,000	1,308,000	Pa.	300,000	398,000
Ia.	368,000	919,000	R. I.	33,000	33,000
Kan.	280,000	1,007,000	S. C.	4,589,000	4,898,000
Ky.	555,000	1,337,000	S. Dak.	209,000	619,000
La.	10,431,000	11,468,000	Tenn.	669,000	1,066,000
Me.	1,287,000	1,335,000	Tex.	6,824,000	7,709,000
Md.	499,000	607,000	Utah	145,000	332,000
Mass.	135,000	172,000	Vt.	73,000	88,000
Mich.	5,111,000	5,671,000	Va.	1,038,000	1,496,000
Minn.	5,909,000	6,757,000	Wash.	689,000	908,000
Miss.	4,752,000	5,648,000	W. Va.	74,000	244,000
Mo.	1,085,000	3,017,000	Wis.	4,046,000	5,122,000
Mont.	79,000	120,000	Wyo.	13,000	28,000
			Total	91,543,000	113,537,000

* Estimates compiled by S. J. McCrory, L. A. Jones, F. J. Morschner, U. S. Department of Agriculture.

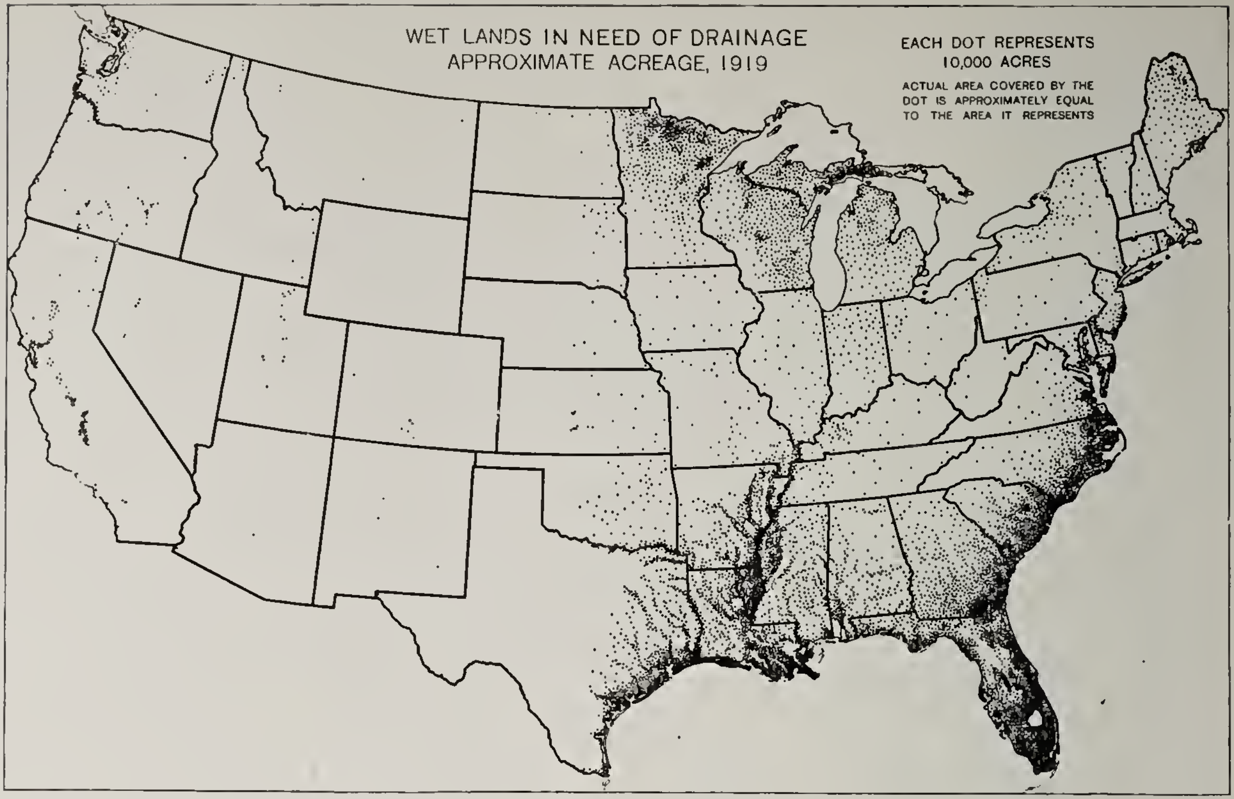
WET LANDS IN NEED OF DRAINAGE
APPROXIMATE ACREAGE, 1919
EACH DOT REPRESENTS
10,000 ACRES
ACTUAL AREA COVERED BY THE DOT IS APPROXIMATELY EQUAL TO THE AREA IT REPRESENTS

FIG. 9

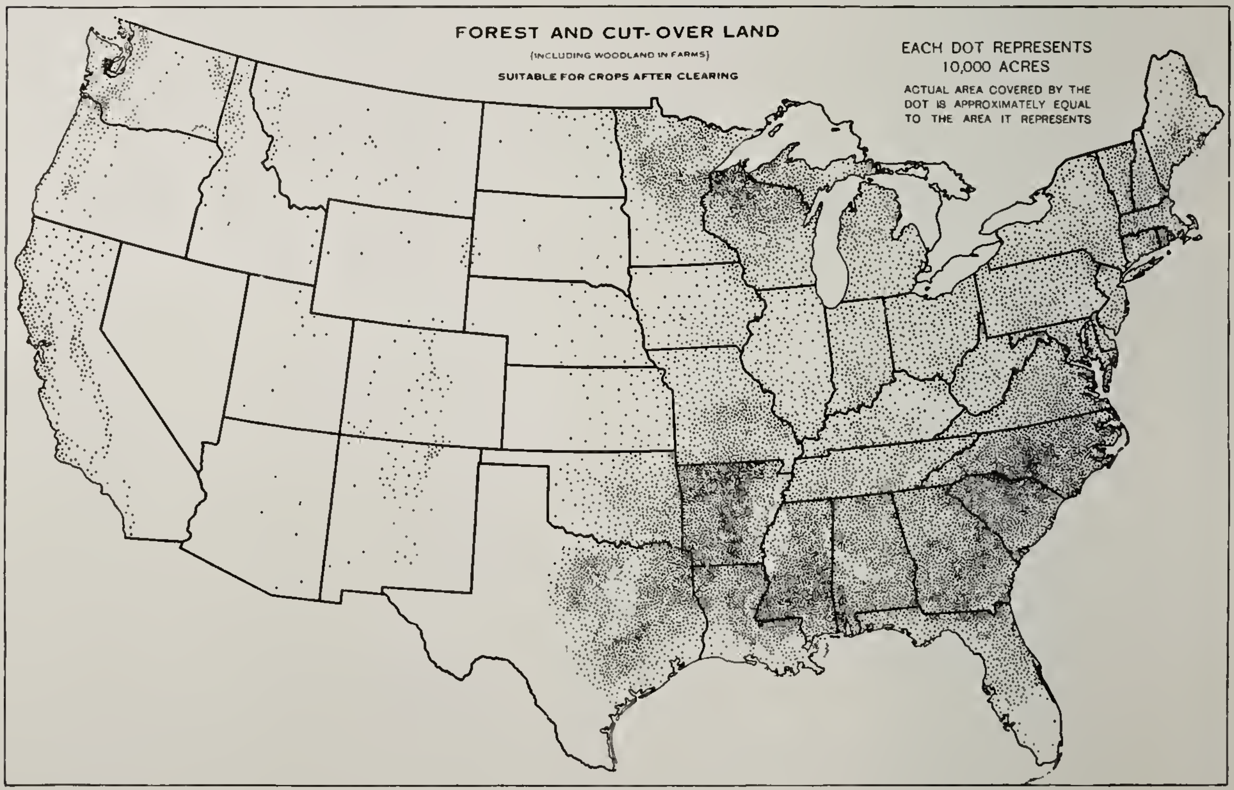
FOREST AND CUT-OVER LAND
(INCLUDING WOODLAND IN FARMS)
SUITABLE FOR CROPS AFTER CLEARING
EACH DOT REPRESENTS
10,000 ACRES
ACTUAL AREA COVERED BY THE DOT IS APPROXIMATELY EQUAL TO THE AREA IT REPRESENTS

FIG. 10

FIG. 9—About 90 million acres of land in the United States are unfit for cultivation without drainage. Two-thirds of this land is in the southern states, and one-half of the remainder is in the three Lake states. A large proportion of the wet land in the South is forested and requires both drainage and clearing, but much of the wet land in the Lake states consists of unforested peat bogs.

FIG. 10—The approximate location and extent of forest, cut-over land, and woodland which could be used for the production of crops after clearing. Fully 60 million acres will require drainage also. This map should be considered tentative only. Revised estimates are being compiled, based largely on 1920 census figures.

TABLE IV—AVERAGE YIELD PER ACRE OF CROPS, 1908–13
(*Cereals and potatoes in bushels; hay in tons*)

	WHEAT	OATS	BARLEY	RYE	POTATOES	HAY
Germany	31.5	54.5	40.8	26.6	201	1.88
United States	14.6	30.2	23.9	15.6	95	1.33

that is likely to prove more profitable for agricultural than for forest use, and 16 per cent for the upland pastures of the East and dry-land pastures of the West that might be used for crops, we have a total of 47 per cent potential increase in agricultural production through reclamation. Forty-seven per cent of 125 million people is nearly 60 million, which added to 125 million amounts to 185 million people. Apparently, therefore, on the basis of these estimates, the arable land of the United States, both present and potential, at its present yields per acre, is capable of providing with food and fibers about 185 millions of people having the same per capita consumption as at present. This is the population which Dr. Pearl estimates will be reached in the year 2000. Whether all this reclaimable land will, by that date, be brought into use for crops is doubtful; it certainly will not unless the prices of agricultural products are much higher than at present.[2]

INCREASE THROUGH MORE INTENSE CULTIVATION

But agricultural production can be increased by growing more food and fiber to the acre as well as by expanding the acreage. Here again, as with population, prophecy is hazardous; but let us assume that our crop yields 50 years hence will be equal to those in Germany before the war, whose soils certainly average no better than ours. Table IV compares the average yield per acre of six leading crops. It is impossible to compare Germany with our country in yield per acre of corn, the great crop which constitutes two-thirds of our total cereal production. It is also difficult to estimate how much the yield per acre of corn might be increased; for, despite the efforts of all our agencies for the promotion of agriculture, the average yield per acre of corn has not increased appreciably since the Civil War. Cotton is in a similar case, owing in part to the ravages of the boll weevil. Let us, therefore, assume that the yields per acre of the principal crops, except corn and cotton, will increase in the United States to equal those in Germany before the war but that the yields per acre of corn and cotton will remain constant. On this basis we may expect an increase in agricultural production of about 33 per cent. This increase in yield applied to our present arable acreage would provide a quantity of agricultural products sufficient for

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[2] Purchasing-power price is meant throughout this article, except where otherwise noted.

166 millions of people, and, applied to both our present and potential acreage of arable land, it would provide enough for 250 millions.

Increase through the Use of Improved Pasture for Crops

There is still another factor in this problem requiring consideration. We had in 1910, according to the census, about 84 million acres of improved pasture, but there is probably not over 75 million acres today (Fig. 12). Suppose this improved pasture land were used for crops, how much would production be increased? Here we must venture the boldest guess of all and assume that the use of this pasture land for crops would double its productivity; that is we should have a net increase equal to 37 million acres of crop land. This would be almost exactly a ten per cent increase upon our present acreage of harvested crops. We may estimate, therefore, that by merely using our improved pasture for crops we could secure an agricultural production sufficient for 137 million people without reclaiming any additional land or increasing the yields per acre; by reclaiming our reclaimable land in addition, for 200 million people; or by producing increased yields per acre equal to those in Germany prior to the war, for 183 million. By doing all four things—by ceasing to export agricultural products, by using the improved pasture for crops, by reclaiming all the reclaimable land, and by securing increased yields per acre the agricultural production would be sufficient for 275 millions of people having present standards of consumption.

Increase through Changes in Consumption

Lastly, let us suppose that under the compulsion of increasing prices for certain agricultural products and owing to increasing knowledge of food values, the tastes of our consumers changed—that to a large extent they gave up eating meat and substituted therefor dairy products and various vegetable proteins and oils. Fully three-fifths of the crop acreage in the United States, or about 225 million acres, is used to produce feed for farm animals; and, in addition, our live stock consume the product of about 75 million acres of improved pasture, probably of 150 million acres of unimproved grassland pasture in farms and about 200 million acres of woodland pasture in farms and in our National forests, besides that of perhaps 500 million acres of arid or semiarid open range land in the West. It seems safe to say that the live stock consume two-thirds of the product of the improved land and practically all the product of the unimproved pasture, or fully 80 per cent of the total food and feed produced by tame and wild vegetation in the United States.

But, as horses and mules consume about one-quarter of this total, only about 60 per cent of the food and feed in the United States is used to produce meat, dairy, and poultry products. The food value of the meat and eggs, however, constitutes only 23 per cent, and the food value of the milk and dairy products about 16 per cent—if calories may be taken as a basis—of the total food consumption of the American people. That is the 20 per cent of the land growing wheat, rye, vegetables, and other crops used directly for human consumption supplies over three-fifths of the food consumed by the American people; while the 60 per cent of the land used to feed meat and milk animals supplies less than two-fifths. The consumption of meat (including lard and poultry) per capita in the United States is now about 170 pounds, whereas in Germany before the war the consumption was about 100 pounds, and in Japan it is only four pounds. The annual per capita consumption of meat in the United States could probably be cut to 50 pounds without injury, if compensated by proportionate increase in use of dairy products and vegetables. Such diet, fully as nutritious as our present partial meat diet, would enable the nation almost to double its population without diminishing its real welfare.

The Limits of Agricultural Production

Briefly, then, our arable land, present and potential, if fertilized and cultivated like the land of Germany, could provide food and fibers in accordance with our present tastes for about 250 million people, and with a largely vegetarian and dairy diet for from 400 to 500 millions, so long as the supply of fertilizer held out. Europe, which is comparable with the United States in area but probably has somewhat greater agricultural resources, had, before the war, a population of about 450 millions. Probably 100 millions of these were fed upon imported food. However, if the lands of Russia produced yields like those of western Europe the continent would have been self-supporting agriculturally.

But it will require more labor per unit of product to cultivate the land so intensively; the price of farm products consequently will be higher, and a larger proportion of the national effort will necessarily be devoted to agriculture. Once we attain a stationary population, however, and need not provide new houses for the increasing population, nor build new roads and railroads, nor irrigate, drain, or clear new land, it may be possible to devote this greater proportion of the nation's labor and capital to agriculture without diminishing the per capita income below the present level. In all probability, however, the standard of living will be much like that in Europe today.

The Present Trend in Land Utilization

After this long flight into the realm of statistical fancy, let us return to solid ground and note the actual trend in land utilization during recent years. The figures now available from the 1920 census show significant changes during the preceding decade. There was an increase for the country as a whole of nearly 77 million acres of land in farms, but of less than 25 million acres of improved land. Land in crops, however, increased 45

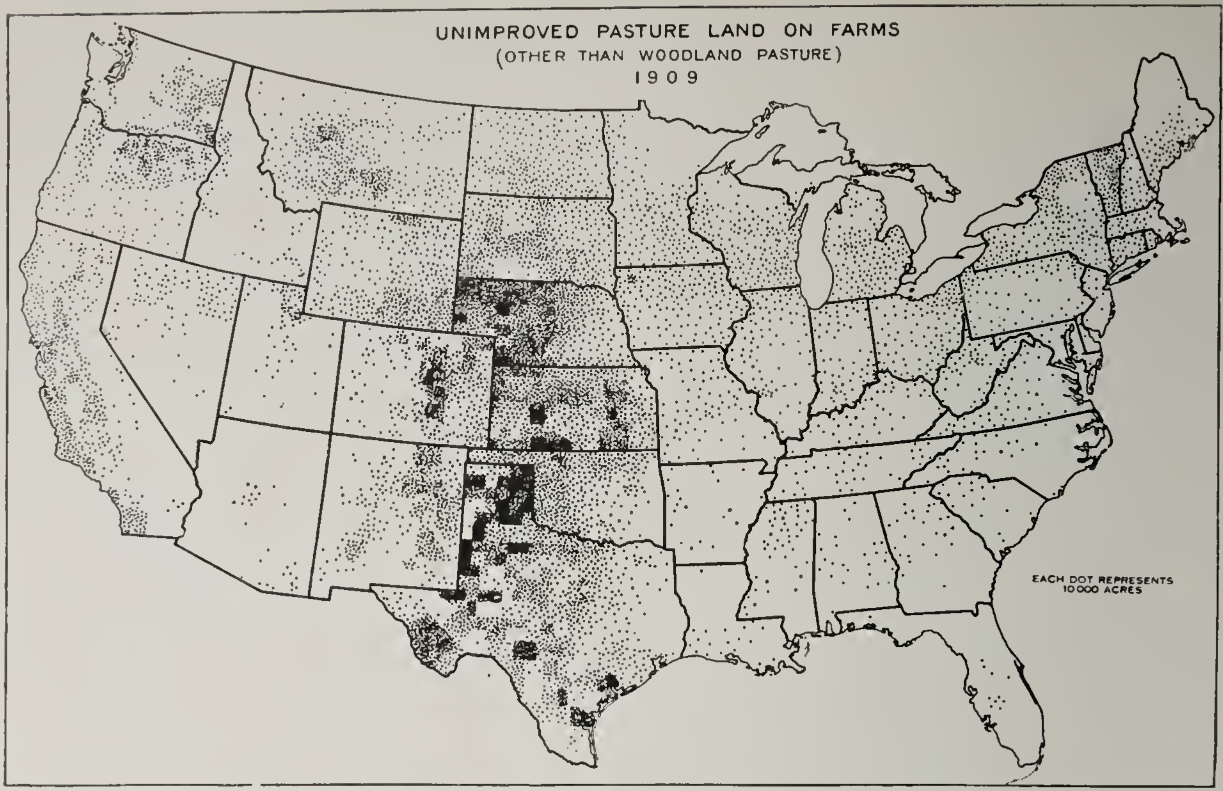
UNIMPROVED PASTURE LAND ON FARMS
(OTHER THAN WOODLAND PASTURE)
1909
EACH DOT REPRESENTS 10000 ACRES

Fig. 11

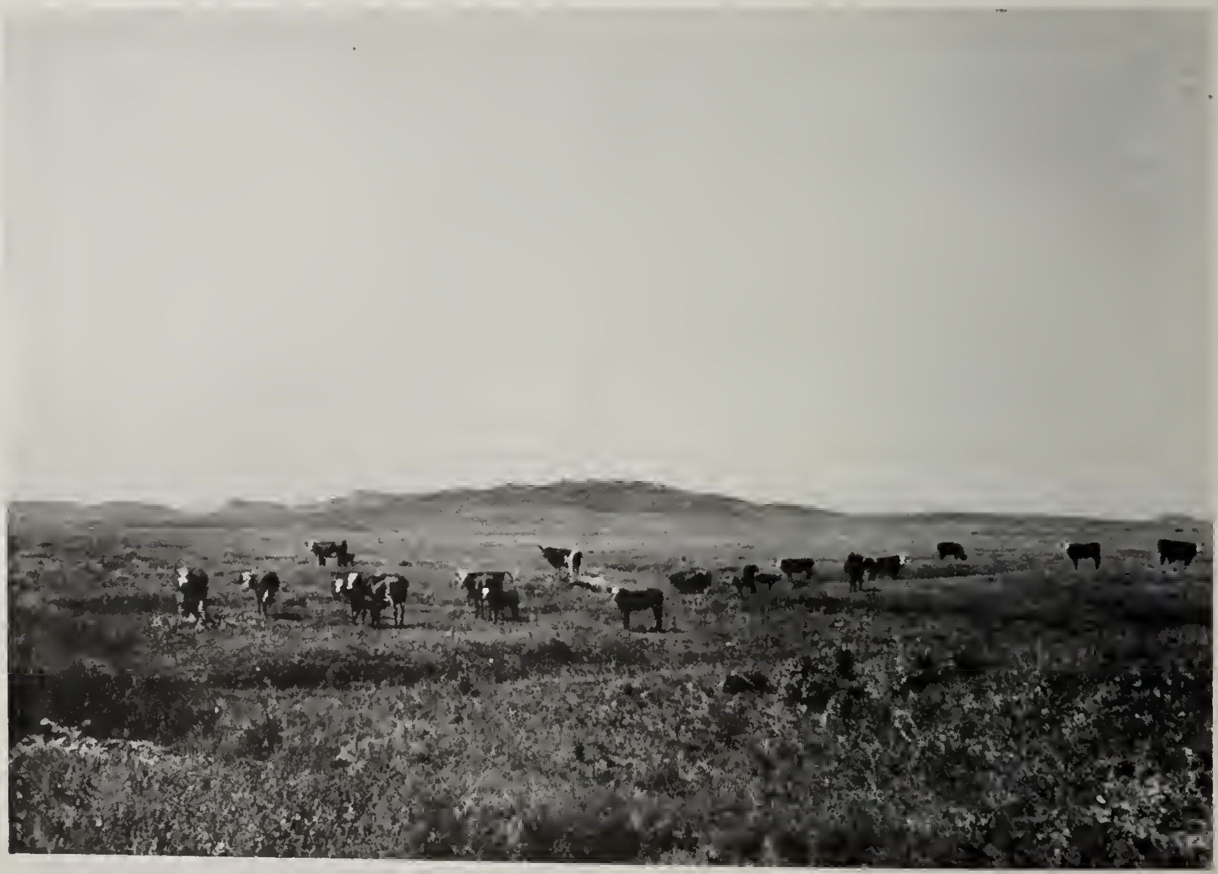

Fig. 12

Fig. 11—Unimproved pasture in farms (other than woodland pasture) amounted to over 100 million acres in 1909 (statistics for 1919 are not yet available). In the West this unimproved pasture will be fenced in gradually, and much of it called improved pasture. In the East some unimproved pasture has been reverting to forest; but, on the other hand, some poorer quality improved land has been reverting to unimproved pasture.

Fig. 12—This picture, taken in southeastern Montana, shows the kind of unimproved semiarid pasture which is being fenced in and, in its better portions, sometimes put into crops the yield of which is abundant in the occasional wet season. There are 100 million acres of such marginal grassland in the United States on which a speculator may make a modest fortune one season growing wheat and lose it all the next season. (Photograph by J. S. Cotton.)

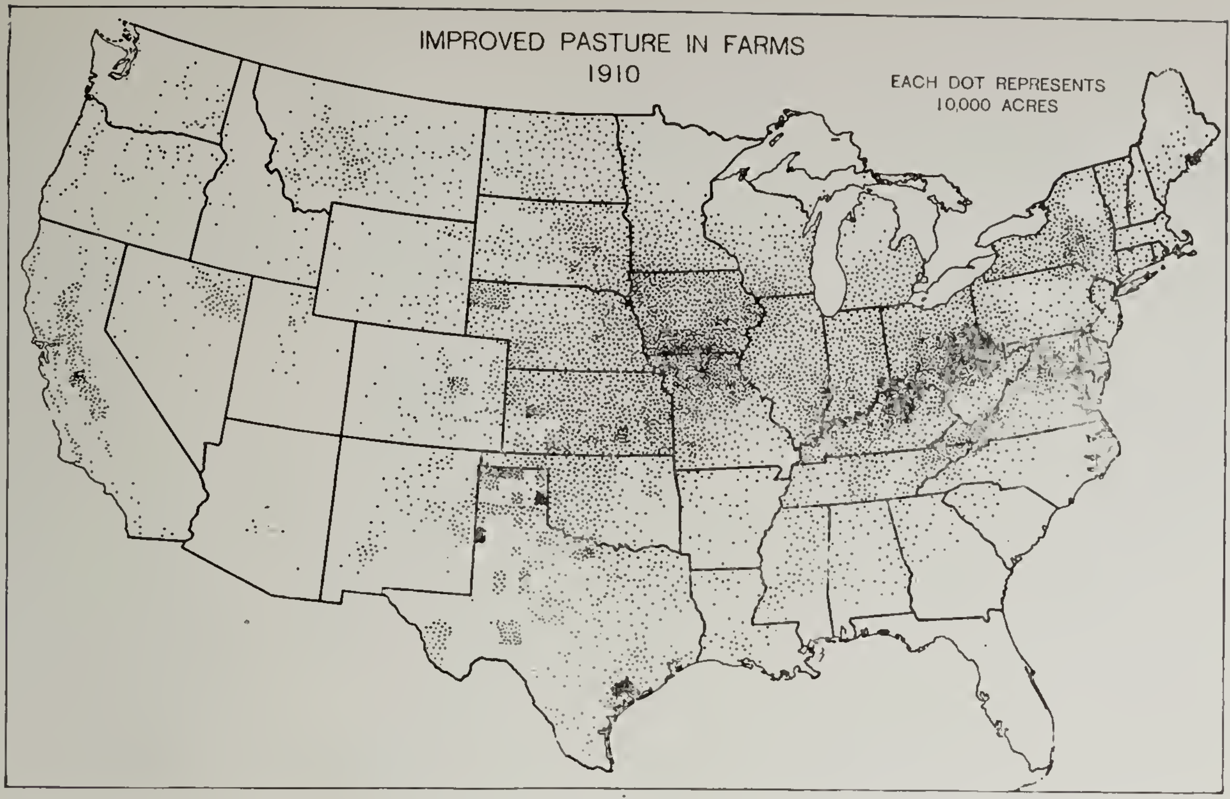

FIG. 13

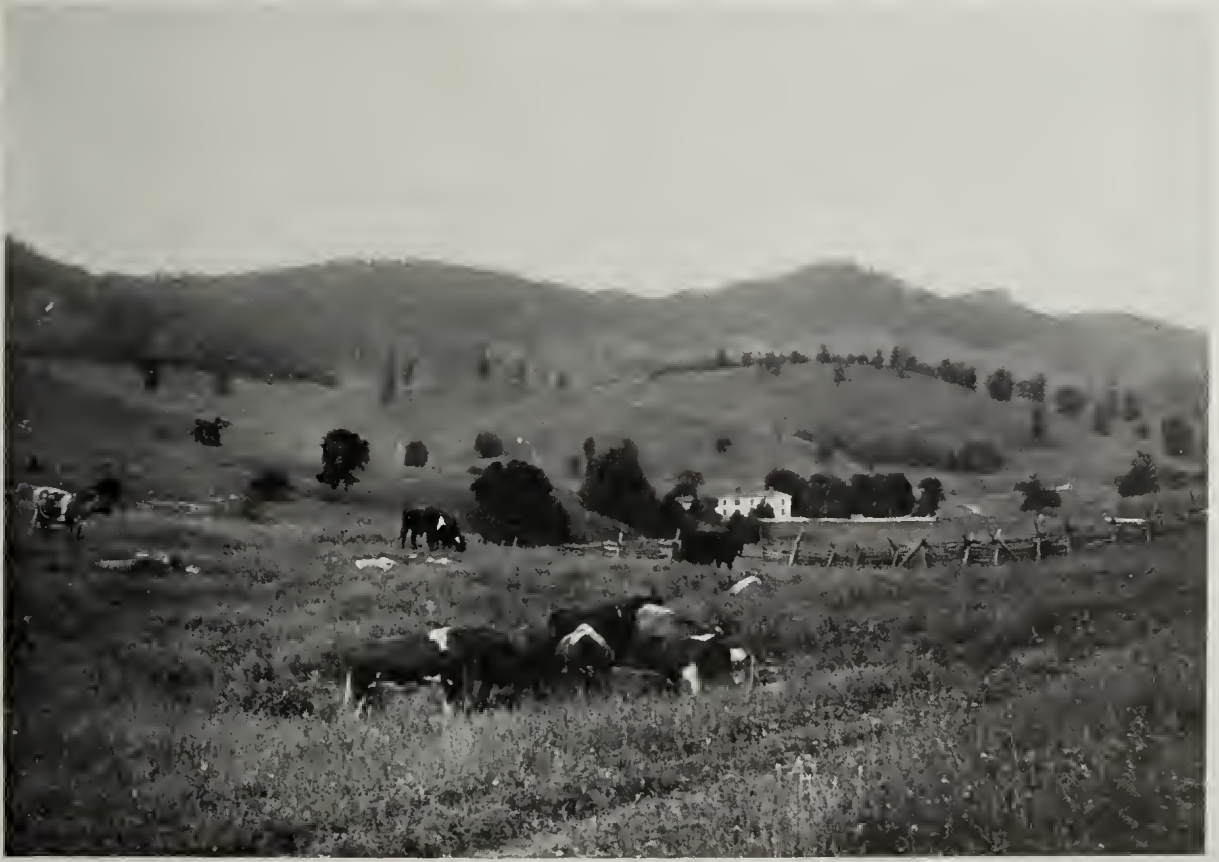

FIG. 14

FIG. 13—There were 85 million acres of improved pasture land in the United States in 1909; but, owing to the plowing up of some of this pasture for crops, probably not over 75 million acres remain today. The large acreage in the Ohio River valley and in the corn belt is noteworthy.

FIG. 14—Rich limestone land in the Valley of Virginia (Tazewell County) which is kept in pasture because, were it used for crops, the soil would rapidly wash away. Where the slopes become very steep along the mountain ridge in the background the land is kept in forest. In general, land having over 15 feet fall in 100 should not be used for crops, and that having over 25 feet should be used for forest. (Photograph by J. S. Cotton.)

million acres. In other words, there was a large increase of unimproved land in farms and of area in crops, and probably a large decrease in improved pasture and other improved land not in crops. Patriotic motives, supported by the high prices paid for farm products during the war and for some time afterward, evidently caused the plowing up and planting to crops of much improved pasture.

Since 1919, with lowering prices of farm products, much of this crop land has returned to pasture; and probably more will be seeded down during the next few years. But this increase of crop land during the war, largely at the expense of improved pasture land, is indicative of what is likely to happen again when rising prices stimulate increased production. It suggests that the demands of our growing population are likely to be met by more intensive use of the better land rather than by the extension of crop production onto the poorer lands.

The cultivation of this greatly increased acreage of crops was accomplished by an apparently decreased number of farmers and farm laborers. The number of persons engaged in agriculture decreased, according to the census, from 12,386,000 in 1910 to 10,659,000 in 1920.[3] This cultivation of 14 per cent more crop land by 14 per cent fewer farmers and laborers, without diminution in yield per acre, can be fully explained only by greater use of machinery, of fertilizer, and other forms of capital. The nominal value of implements and machinery on farms increased nearly three-fold between 1910 and 1920, or, allowing for increased prices, the farmers in 1920 were using machinery having about 50 per cent more real value than in 1910. The quantity of fertilizer used in 1919 was 40 per cent greater than in 1909. This notable increase in efficiency of the American farmer suggests that increased production, for the present at least, will be achieved by the greater use of capital rather than of labor. American agriculture shows no tendency as yet to degenerate into a peasant type of farming.

Geographical Distribution of Changes in the Use of Land

This trend in land utilization becomes of greater significance when considered geographically. Dividing the United States into a humid eastern and a largely arid or semiarid western half by a line passing through the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, about midway of the belt in which crops give place to grazing as the major means of agricultural production, we find that the increase of land in farms was practically confined to the western portion of the country (Fig. 15). The eastern states show a notable and widespread decrease in farm land between 1910 and 1920, except in the northern portions of Michigan, Wisconsin, and Minnesota, which have been undergoing settlement, the Ozark section

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[3] However, as the 1920 census was taken January 1 and the 1910 census was taken April 15, it appears likely that a large number of farm laborers were missed or assigned to other occupations by the enumerators in 1920. Making allowance for this discrepancy, it seems certain that the acres of crops per person engaged in agriculture increased at least one-sixth between 1909 and 1919, and the production per person even more.

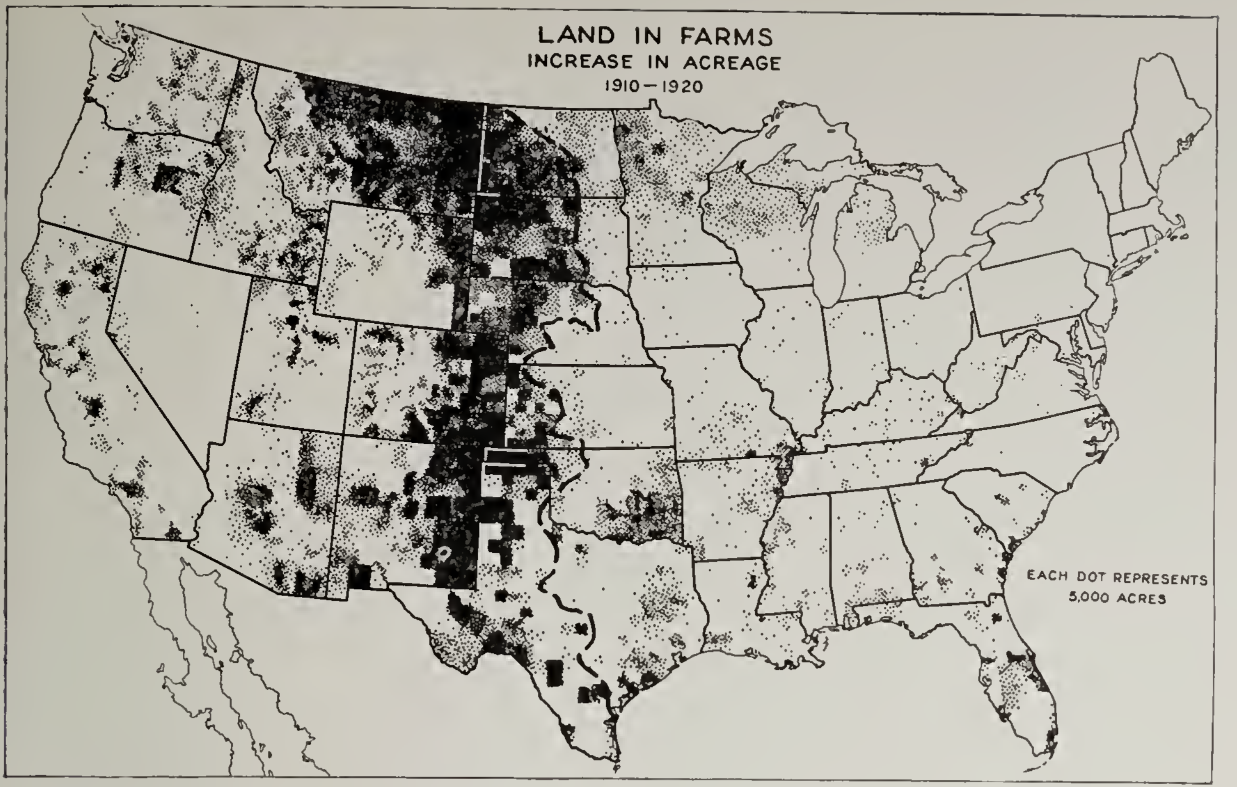

FIG. 15

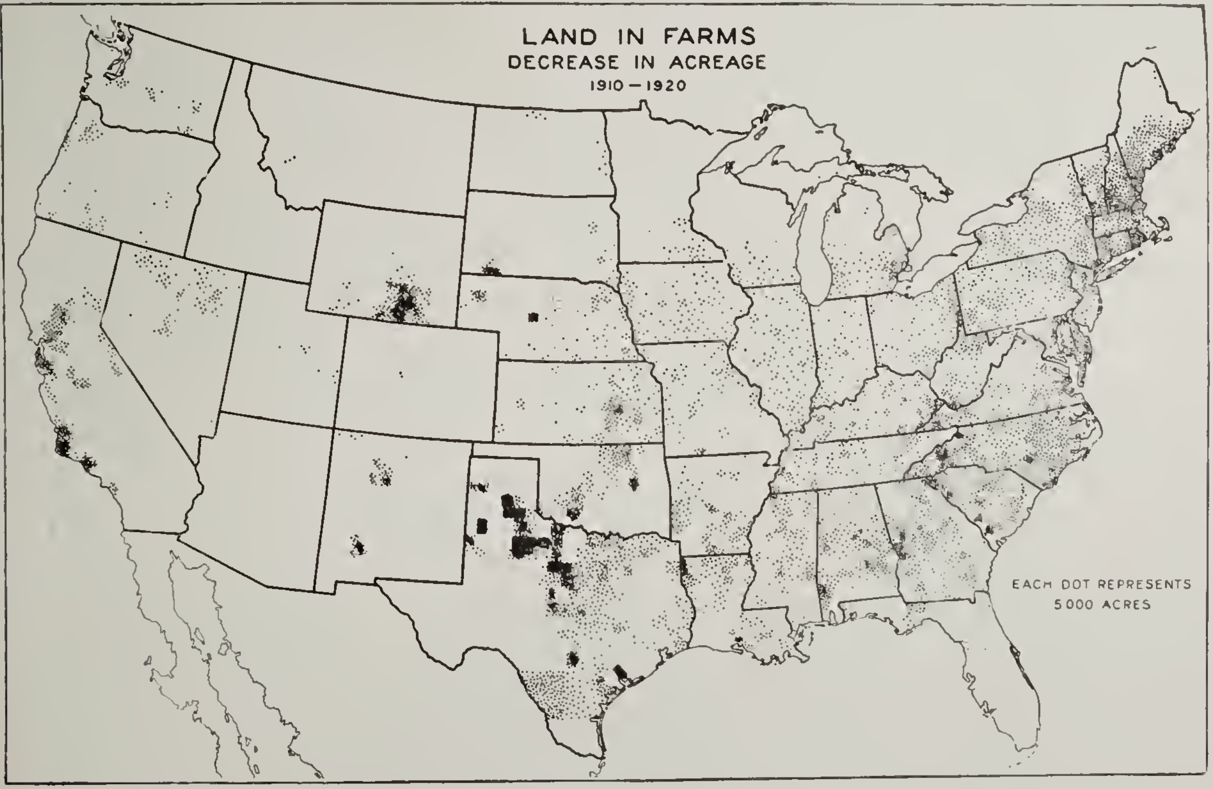

FIG. 16

FIG. 15—The notably great increase in acreage of land in farms in the Great Plains region and far western states was owing principally to the enactment of the Enlarged Homestead Act in 1909 and the Grazing Homestead Act in 1916, which authorized entry on 320 and 640 acres of land, respectively. The dashed line is drawn along the eastern margin of the Great Plains region, where grazing gives place to crops as the major means of agricultural production.

FIG. 16—The decreases in acreage of land in farms shown in Texas are mostly nominal rather than real, being due to shifts from one county to another of the headquarters of large cattle ranches. The decrease in the South is owing largely to the inclusion of less forest land within the farm boundaries in 1920 than in 1910. In New England it is due partly to this cause and partly to the reversion of some pasture land to forest.

of Missouri, which is still in process of agricultural development, and several counties in Arkansas and Florida where large areas of land have been reclaimed by drainage or clearing (Fig. 16). A number of counties in those portions of the Dakotas, Oklahoma, and Texas included within this eastern division also showed an increase of farm land. The aggregate decrease of farm land in the eastern portion of the country amounted to seven million acres, while the increase in the western portion was 84 million acres.

Both the decrease of farm land in the East and the increase in the West, however, were more nominal than real. In the southeastern states the decreased area of farm land is almost wholly accounted for by the decreased area of woodland in farms, not due to clearing but to including less of the adjacent forest within the farm boundaries. In the corn belt a small portion of the decrease in farm land can be attributed to the growth of cities and villages, but the major portion of the decrease indicated is inexplicable on any other basis than incompleteness of enumeration. In New England, New York, Pennsylvania, Maryland, and Virginia, on the other hand, there has occurred, undoubtedly, a real and notable decrease in the extent of the arable area.

In the western half of the nation the enormous increase in area of farm land is accounted for very largely by the enactment of the Enlarged Homestead Law in 1909 and the Grazing Homestead Law in 1916, which encouraged thousands of young men to apply for half-sections and sections of public land that was being used by adjacent ranchmen for grazing cattle and sheep. Most of this land fortunately has been permitted by the homesteaders to remain in wild grass, as is indicated by the fact that of the reported increase of 84 million acres of farm land in this western half of the nation 60 million acres were unimproved. Transformation of this western range into so-called farm land, in other words, has not involved much increase in intensity of its utilization; in fact, in many localities it has decreased agricultural production. On non-irrigated farms and ranches in the western states there were, apparently, about the same number of live stock in 1920 as in 1910.

A much better criterion of changes in the extent of arable land than the statistics of land in farms is to be found in the figures of crop land (Table I). The acreage of land in crops, wholly unlike farm land, shows a remarkably large and universal increase between 1910 and 1920 (Fig. 17). Only 500 counties out of 3066 in the United States show a decrease in crop acreage during the decade (Fig. 18). This decrease was practically confined to New England, eastern New York, and northern New Jersey; to several counties in central Illinois and in central Alabama and the silty uplands of Mississippi, also in southern Louisiana and southeastern Texas; to the Flint Hills district of Kansas and the adjacent portion of Oklahoma; and to the Sierra and the San Francisco Bay and adjacent coast counties in California. The increase in acreage was notable in western Ohio and northern Indiana, in the lower Coastal Plain of Georgia and Alabama, and along the

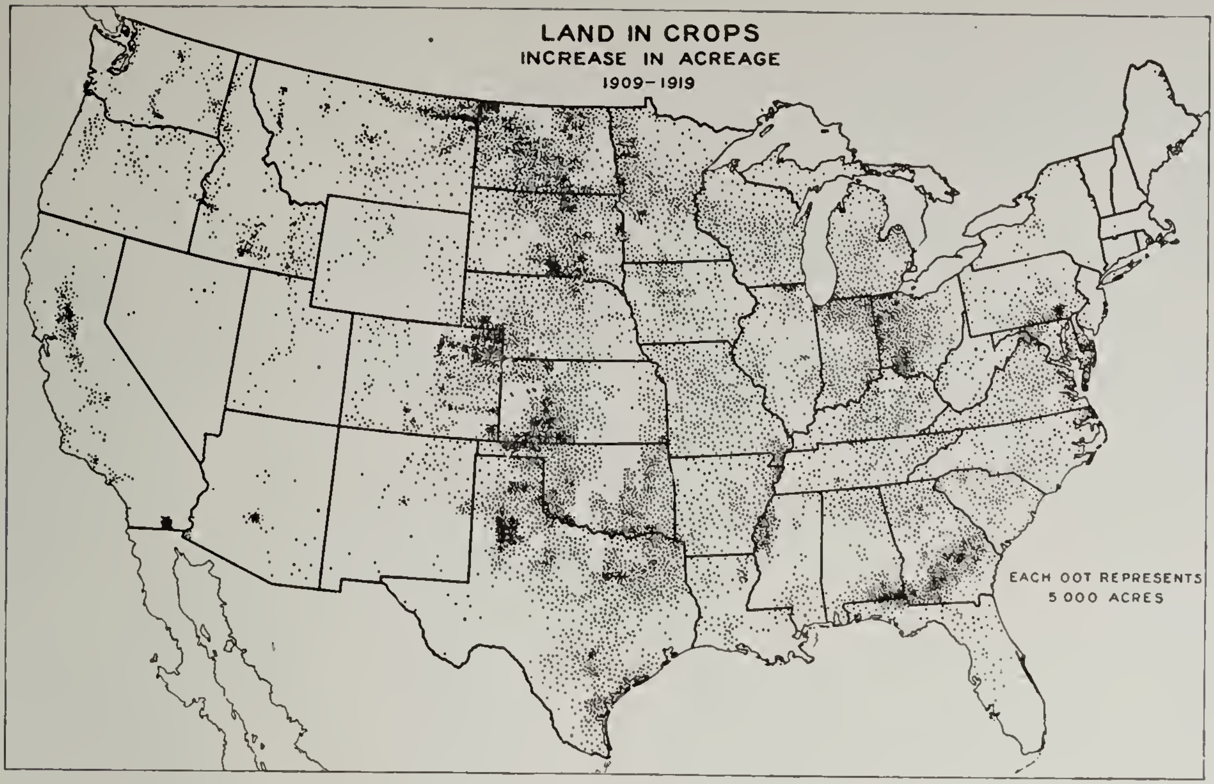

FIG. 17

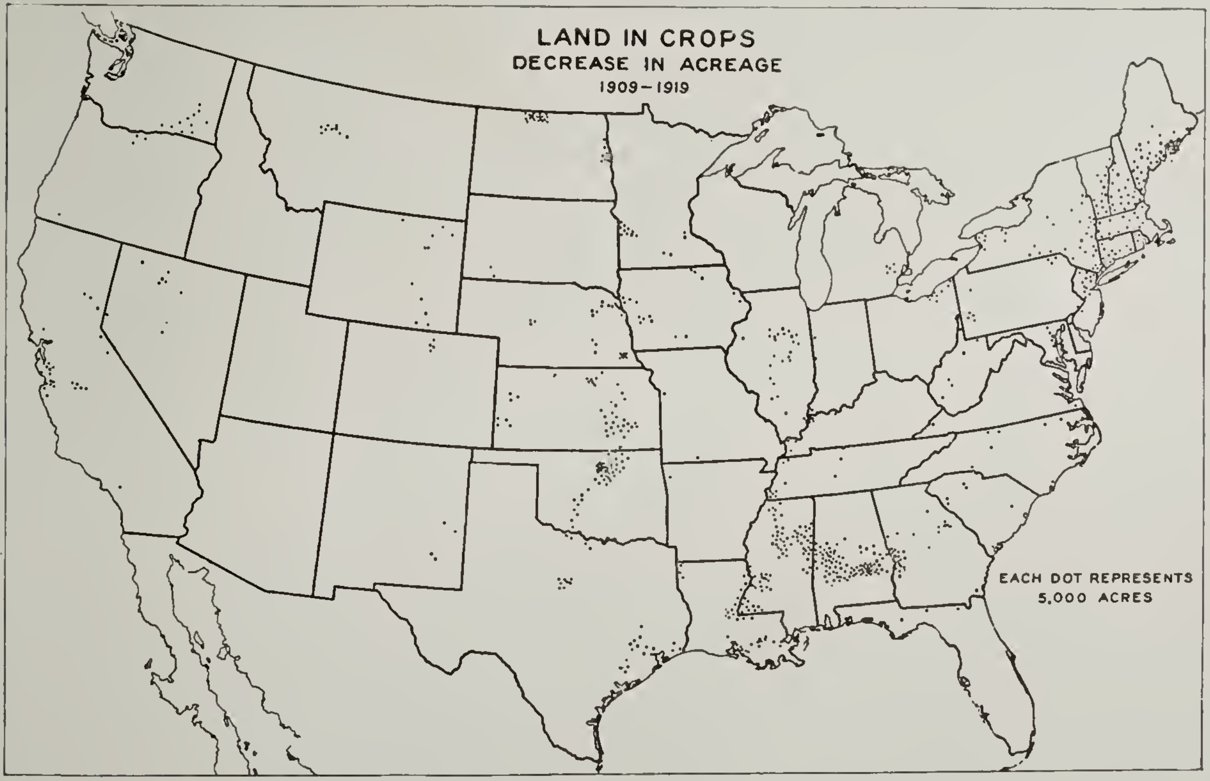

FIG. 18

FIG. 17—The acreage of land in crops, wholly unlike farm land, shows a remarkably large and almost universal increase between 1910 and 1920, amounting to nearly 50 million acres. Patriotic motives, supported by the high prices paid for farm products during the war and for some time afterward, caused the plowing up and planting to crops of much improved pasture.

FIG. 18—The decrease in acreage of land in crops between 1910 and 1920 was practically confined to New England, eastern New York, and northern New Jersey; to the fertility-depleted Black Prairie belt of Alabama and Mississippi and the silty uplands in the southwestern corner of that state, in several counties in Louisiana, and in southeastern Texas; and to the Flint Hills of Kansas and the adjacent section of Oklahoma.

Great Plains border from Montana to Texas. The net increase in crop land in the eastern half of the United States amounted to nearly 30 million acres, and in the western half to about 20 million acres.

The trend in land utilization during the decade clearly has been toward the more intensive utilization of the more fertile, level, or favorably located land, that is its use for crops rather than for pasture; and toward the less intensive utilization of the less fertile or less favorably situated land, that is its use for unimproved pasture or forest. Despite the high prices of agricultural products, which still continued in 1919 when the census was taken, much improved land of poor quality in the eastern half of the United States had been allowed to revert to unimproved pasture, and much unimproved pasture to forest; while at the same time the better pasture land was plowed up and put into crops. In the West likewise, outside the Great Plains region, the increase in irrigated land was about equal to the entire increase of improved land, indicating no extension, on the whole, of the area of dry-land farming. The situation in the Great Plains region is too uncertain, as yet, to permit a definite statement.

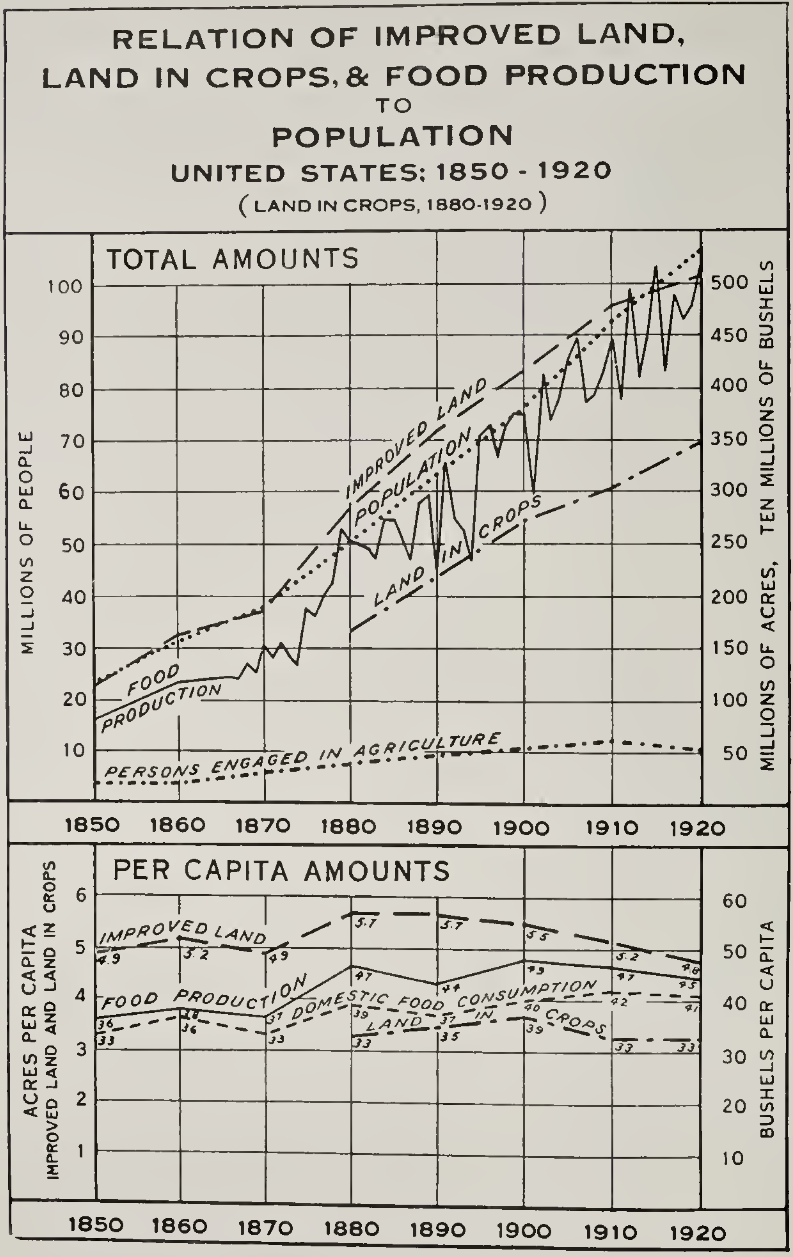

Fig. 19—Food production increased more rapidly than population till about 1906, since when it has increased more slowly than population. Consumption per capita has been maintained up to the present time by diminishing the exports. The per capita production and consumption figures are 5-year averages centered on the census year.

The Trend in Agricultural Production

There has been no diminution of production, however, because of this concentration of labor on the more fertile or favorably located land, but instead an increase, not only per person engaged in agriculture but also in total product of the area or region. In New England, for instance, where this trend in land utilization has been notable, the acreage of hay, which constitutes over 80 per cent of the acreage of all crops, has constantly decreased since 1879, while the production of hay has almost as constantly increased and was greater in 1919 than in any previous census year. In 1879 the average yield per acre was less than one ton, whereas in 1919 it had increased to 1.13 tons of hay and 1.48 tons of hay and forage combined.

For the United States as a whole the increases in the average yields per acre of the more important crops during the decade 1911 to 1920 as compared with the decade 1866 to 1875 were: corn, 0.3 bushel (1 per cent); wheat, 2.7 bushels (23 per cent); oats, 4.1 bushels (14 per cent); barley, 2.4 bushels (10 per cent); potatoes, 3.0 bushels (3 per cent); rye, 1.8 bushels (14 per cent); hay, .05 ton (4 per cent); cotton, 1 pound (1 per cent). Considering food alone, as indicated by the total production of corn, wheat, rye, oats, barley, rice, buckwheat, Irish potatoes, sweet potatoes, and sugar, expressed in units approximately equivalent to a bushel of wheat, the per capita production for the total population was for the year 1849, 36 bushels; for 1859, 38 bushels; the average for 1866–75, 37 bushels; for 1876–85, 47 bushels; for 1886–95, 44 bushels; for 1896–1905, 49 bushels; for 1906–15, 47 bushels; and for 1916–20, 45 bushels.

It is interesting to compare these figures of production per capita with those of improved land per capita. In 1850 there were 4.9 acres of improved land per person in the United States; in 1860, 5.2 acres; in 1870, 4.9 acres; in 1880, 5.7 acres; in 1890, 5.7 acres; in 1900, 5.5 acres; in 1910, 5.2 acres; and in 1920, 4.8 acres. The maximum acreage of improved land per capita was reached about 1885; the maximum production per capita of food, about 1905 or 1906, or 20 years later. Apparently we have reached that stage in our agricultural development when neither increasing acreage nor increasing yield per acre is able to maintain production per capita (Fig. 19).

Means of Increasing the Supply of Agricultural Products

Heretofore, the supply of agricultural products in the United States has been increased mainly by extension of the arable area and by improvements in agricultural technique. Hereafter, it appears probable, it will be increased by at least five other methods, i.e. by greater intensity of cultivation, by diminishing waste, by reducing our exports, by increasing our imports, and by gradual shifting from a diet in which meat figures prominently to one largely confined to the cereals, vegetables, and dairy products. The greater intensity of cultivation is already indicated by the increasing proportion of farm land devoted to crops; the increasing proportion of crop land devoted to vegetables, tobacco, and other intensively cultivated crops; and the increasing yield per acre of most of the crops. Diminished waste in transportation and marketing is being attained by refrigerator cars, cold-storage facilities, utilization of by-products, especially in the meat-packing industry, and by orderly marketing. Our net exports of foods have been reduced from about 17 per cent of our production during the decade 1896–1905 to about 12 per cent during the five years 1916–1920. For the five years prior to the war the net exports of food products constituted only 5 per cent of the production. That the change in diet is already in progress is indicated by a beef consumption per capita only three-quarters as great now as it was 15 years ago.

Importation of Agricultural Products

The most important factor, in my opinion, to be evaluated in considering a national policy of land utilization is that of the competition in our markets of agricultural products from foreign countries, particularly from the tropics. Although there is in Siberia a vast expanse of undeveloped arable land, probably as great in amount as the total arable land of the United States, both improved and unimproved; and although there are considerable areas of fertile land as yet undeveloped in Argentina, Australia, and other countries of temperate climate, nevertheless, the great reservoir of unutilized agricultural resources is to be found in the tropics. Tropical and subtropical countries include approximately half of the arable land, present and potential, of the world. Of the arable land in these countries less than one-fourth (about 1200 million acres) is in cultivation at present, and possibly one-eighth is used for pasture; whereas in the temperate zones fully one-half of the ultimately arable land is now in crops, and almost another third is used for pasture. Apparently the tropics and subtropics include about three times as large an area of potentially arable land as that which remains undeveloped in the temperate zones. Most of this land in the tropics is cheap; and, although the task of clearing or reclaiming is quite generally more or less difficult, labor is much cheaper in tropical countries than in the United States.

The competition in our markets of the products of this cheap land and labor appears likely to become increasingly serious for the American farmer. For several years the production of sugar in tropical lands has exceeded that in the temperate zones, and it may be questioned whether without the protection afforded by the tariff the sugar growing industry in the United States would be able to maintain itself. In recent years the manufacture of vegetable oils from tropical nuts and seeds likewise has developed rapidly and is already affecting the demand for lard, butter, and other animal fats. It seems likely that our increasing demand for agricultural products, consequent upon an increasing population, will be supplied in increasing proportion by imports from foreign lands, especially the tropics, unless the nation decides to maintain a policy of tariff protection.

The importation of agricultural products is further favored by the extraordinary purchasing power the people of the United States have attained, particularly since the World War. The favorable rate of exchange facilitates our purchase of commodities in foreign countries at the same time that it places an obstacle in the way of foreign purchasers buying from us. So favorable a rate of exchange is, of course, temporary; but the vast accumulation of capital in this country which must in part seek investment in foreign countries will encourage in increasing extent the importation of agricultural products as payment of dividends on these foreign investments.

TABLE V—ARABLE LAND OF THE EARTH

Tropical and subtropical zones		
Total land area	23,000,000	sq. miles
Land too arid for crops	8,000,000	" "
Land with adequate rainfall	15,000,000	" "
Probably one-third ultimately arable	5,000,000	" "
Cultivated at present	1,200,000	" "
Arable land in pasture	600,000	" "
Potentially arable not used for crops or pasture	3,200,000	" "
Temperate zones		
Total land area	29,000,000	" "
Land too dry for crops	7,600,000	" "
Land too cold for crops	6,400,000	" "
Land with adequate rainfall and heat	15,000,000	" "
Probably one-third ultimately arable	5,000,000	" "
Cultivated at present	2,500,000	" "
Arable land in pasture	1,500,000	" "
Potentially arable not used for crops or pasture	1,000,000	" "

Those who seek to stimulate expansion of the agricultural area in the United States by bringing into use for crops land of poorer quality or land which requires heavy expense for drainage or irrigation, must reckon with this competition from the cheaper land and labor of foreign countries and with the fact that those countries must pay for the use of American capital largely with agricultural products.

NATIONAL WELFARE THE BASIS OF A NATIONAL LAND POLICY

Whether it is desirable to afford protection to our agriculture in order to promote its expansion involves many questions of policy both economic and social. If after mature discussion it appears advisable to embark upon a policy of protection for our agricultural industries, it is important that the expansion of the agricultural area be promoted in accordance with broad plans of national scope, based on the principle of national welfare. The obstacles to be overcome in the reclamation by drainage, irrigation, or otherwise, of the lands that remain unused will increase in difficulty and magnitude as the more feasible projects are completed and will inevitably require in increasing extent the resources and credit of the government.

Before such costly public works are undertaken, it is important that the rate, the time, and the direction of expansion of our arable area be carefully studied.[4] The rate of expansion should depend upon the rate of increase of population and the trend of per-capita consumption, of per-acre production, and of exports and imports. The time for expansion should be determined with reference to construction costs and the financial situation. The direction of expansion should involve thorough investigation of soil and climate, with especial reference to crop adaptation and farm organization. A classification of the land of the United States with reference both to physical character and to economic use is basic to an orderly expansion of our arable area. Classification with reference to physical character is being well made by the Soil Survey; but classification with reference to economic use has been made only for small areas and usually incidental to other objects. A survey of the present and potential use of the land is one of our greatest national needs. This survey must include a study of the agricultural resources of foreign countries also, especially of the tropics, whose products are likely to invade our markets in increasing amounts unless excluded by tariff barriers.

In conclusion, it appears appropriate to note again that, although the land resources of the United States make it possible to feed and clothe 400 million people in a manner that will not seriously impair their health and activity, it will probably require a larger proportion of the national effort to do so than is required at present, and there will be less of other commodities, especially the luxuries, available per individual for consumption. The production per capita of agricultural products apparently reached its crest about 1906–07 and is now diminishing. The production per capita of manufactured products is probably still increasing; but, as manufacturing is dependent largely for its raw materials upon agriculture and forestry, manufactured products must soon show also a diminishing production per capita unless there be extensive importation of food and raw materials from abroad. In other words, our nation is probably near, possibly past, the crest of greatest average income per capita; and every increment in population is likely to increase the complaint of the high cost of living.

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[4] See L. C. Gray: Helping Landless Farmers to Own Farms, *Yearbook Dept. of Agric. for 1920*, pp. 271–288.

NATIVE LIFE IN FRENCH NORTH AFRICA*

By E. F. Gautier
University of Algiers

The country bordering the Mediterranean Sea on the south between Tunis and the Atlantic Ocean has no name of its own, at least none in common use. It is known to some as Africa Minor; as it is almost entirely under French control we may call it French North Africa.

It is a long stretch of territory, about 1,200 miles from east to west and 200 miles from north to south. The three countries that compose it—Tunisia, Algeria, and Morocco—form practically one great geographical unit, the Atlas Mountains. The census of 1921 gives the native population in Tunisia and Algeria as 2,000,000 and 5,000,000 respectively. The total amount, Morocco included, may be placed at between 11,000,000 and 12,000,000.[1] The whole of this population is Mohammedan, with the single exception of the Jews; and even these use no other native language than Arabic. For this reason we might borrow from the Arabic the native name for the country, *Maghrab*, as it is known throughout the Mussulman community. True, the name covers not only Africa Minor but Tripoli and the Sahara as well; in fact everything west of Egypt. Maghrab is the western half of the Mohammedan world; the other, the eastern half, being the *Sharq*.

Egypt, the seat of the most ancient and best-known eastern empire, is the most typical part of the Sharq: but Mesopotamia as well, and Palestine, Syria, Persia, Arabia—every province of the Sharq looks back upon a glorious historical past. Sharq is the cradle of the world's civilization, at least of western civilization. Not so Maghrab. Its people are warlike; in fact, war has been one of their greatest achievements. They conquered southern Spain, Sicily, and Egypt, though not on their own account: they have always been under foreign masters. The early dawn of history shows Carthage, a foreign colony of Tyrian settlers, ruling Africa Minor. Later, North Africa was for centuries a province in the Roman empire. Then came the Vandals—a wandering Germanic tribe; then the Byzantines; then the Arabs; then the Turks, whom the French expelled ninety years ago. For it is to be noted that never did any foreign master in Maghrab yield to the pressure of native insurgents. Every one of them has been overthrown and succeeded by another foreign invader.

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* Read at the Joint Meeting of the Association of American Geographers and the American Geographical Society, April, 1922.

[1] Augustin Bernard: Le recensement de 1921 dans l'Afrique du nord, *Ann. de Géogr.*, Vol. 31, 1922, pp. 52–58—abstracted elsewhere in this number of the *Review*.

THE DISTRIBUTION OF LANGUAGES[2]

The North African native languages are only two: Arabic, the language of those who amongst the various foreign invaders introduced Mohammedanism into the country, and Berber, a language which has been at home in the Barbary States from the beginning of history. The native subjects of Carthage and Rome must have spoken a language closely connected with Berber, as is shown by the "Libyan" inscriptions found on tombstones, sometimes with Latin translations; more often on bare rocks, when they occasionally appear associated with very old clumsy drawings of animals, some of them now extinct. The Libyan alphabet is still in use in remote parts of North Africa amongst the Saharan Tuaregs.

Both as a spoken and written language Berber is still in a state of infancy. It is a set of poor disconnected dialects, without grammar or fixed vocabulary; and writing has never been developed further than the rock-engraving stage. The language is on the same level as the people. Like everything Berber, it does not develop; nor, on the other hand, does it disappear and die.

Arabic, of course, compares very favorably with Berber. It is a developed language, fit for administrative, commercial, and literary purposes, at least to a certain extent. And yet after a 1200-year struggle it has not superseded Berber. In Algeria we know definitely the exact number of Berber-speaking natives; they amount to about one-third of the total population. In Morocco, as far as we know, the proportion is reversed. Probably it is not far from the truth to say that in French North Africa one-half of the natives speak Berber, and, though Mohammedan, they know very little or nothing at all about the holy language of the Koran.

A difference of languages is always a serious matter; it is particularly so in this case. A glance at the map shows the puzzling way in which the two peoples and the two languages confront each other. The two domains are interwoven in the most confused way, Arabs and Berbers are scattered in disconnected patches. The object of this paper is to review these several patches, each of which is more or less à separate natural region.

KABYLIA

Amongst the regions inhabited by Berbers the best known is Kabylia, the tract of high, rugged, and wooded mountains along the coast between Algiers and Constantine. There lives a rather crowded population of Berber-speaking natives, almost wholly ignorant of Arabic. They are peasants and more especially gardeners, tending orchards of fig, olive, and orange trees. They dwell in humble cottages, grouped into moderate-sized villages, each of them ranging from a few hundred to a few thousand inhabitants. They are organized into democratic communities, the power belonging to the *jamāʿa*, a body somewhat similar to a town council. According to Masqueray[3] those rural democracies seem closely related to the old Italian communities eight centuries before Christ, at the time when Rome was only a small city amongst many others.

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[2] E. F. Gautier: Répartition de la langue berbère en Algéria, *Ann. de Géogr.*, Vol. 22, 1913, pp. 255–266.

The word Kabylia comes from the Arabic and means tribes, or clans, indicating an organization of democratic character which to the Arabic mind is always puzzling. Anthropologists agree that Berbers, in bodily structure and the shape of their skull, are connected with southern Italians and southern Spaniards rather than with African and Oriental races. On the other hand, though the name Kabylia may be new, the people themselves are very old. They are the "Mauri" of the Latin historians. Kabylia is nothing else than the ancient "Mauretania."[4]

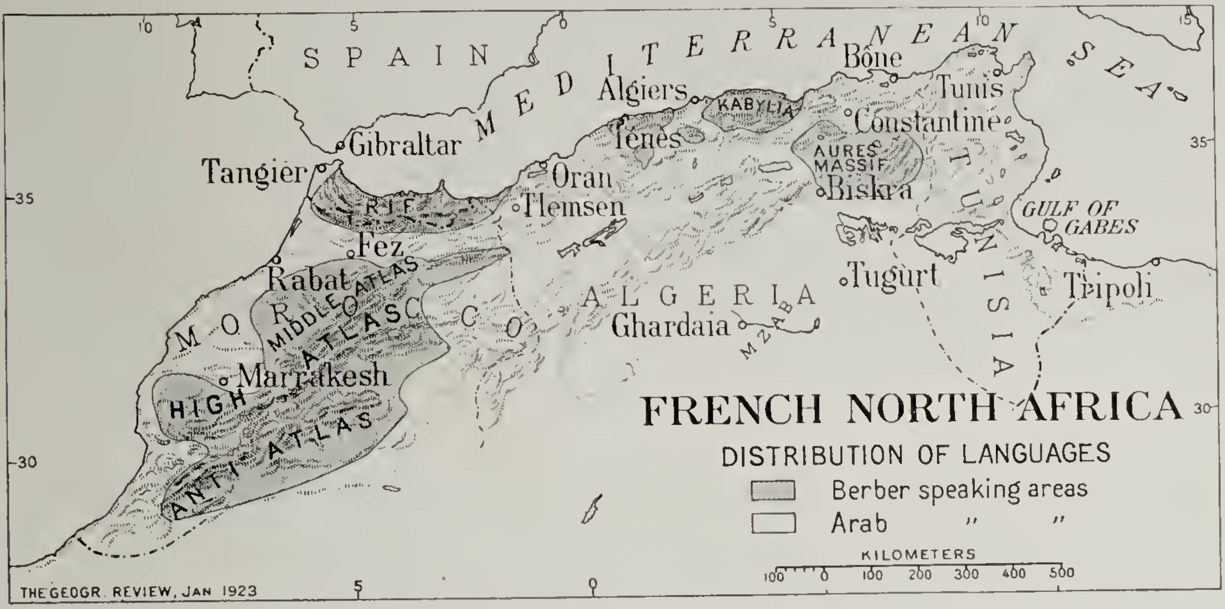

FIG. 1—Sketch map showing in generalized form the distribution of Arabic- and Berber-speaking peoples of French North Africa. Scale approximately 1:21,500,000.

SHAWIYA

Southeast of Kabylia are the Aures Mountains where live Berber-speaking tribes which bear the name of Shawiya. Aures proper is a peculiar little world of high, picturesque valleys, shut in amongst very high mountains, the highest in Algeria. Shawiya extends outside the boundaries of Aures along the high plains in the north; but these plains are much broken up and interspersed by many isolated rugged ridges or crests, standing out like so many rocky fortresses.

The Shawiya resemble the Kabyles in many important features; they too are rural democracies governed by *jamā'a*, and their villages are very much like the Kabyle ones, as far as topographical situation is concerned; both occupy impregnable positions crowning the tops of steep hills.

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[3] Émile Masqueray: Formation des cités chez les populations sédentaires de l'Algérie, Paris, 1886.

[4] See Stéphane Gsell: L'Algérie dans l'antiquité, Algiers, 1903.

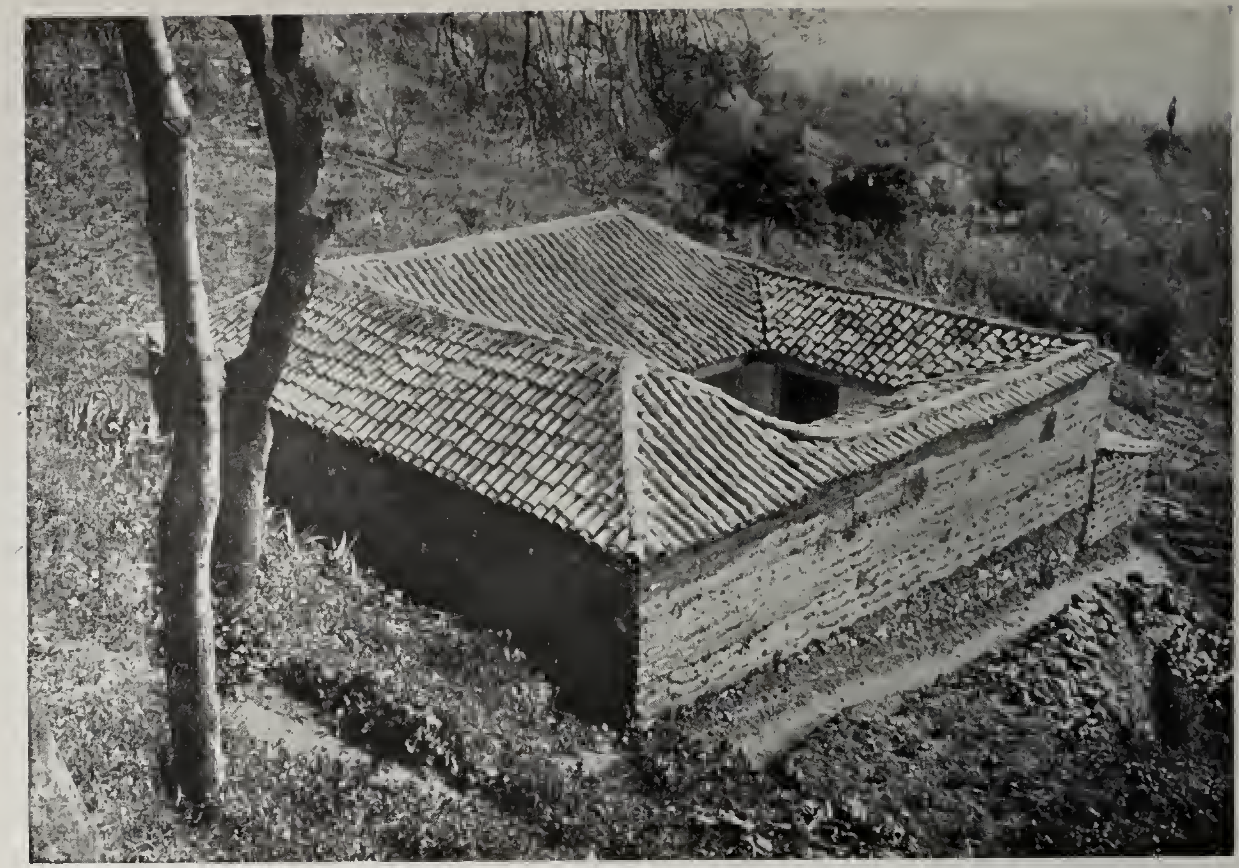

FIG. 2

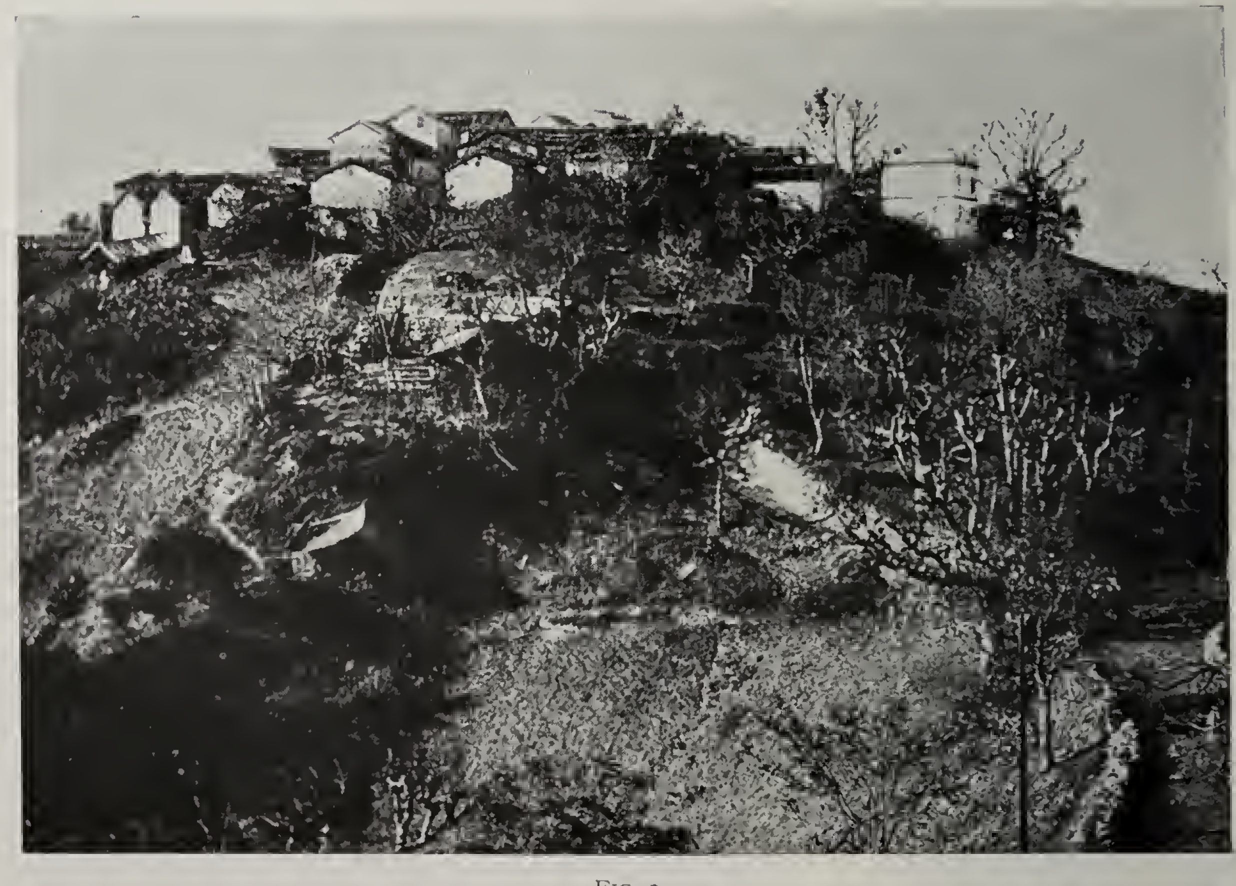

FIG. 3

FIG. 2—A Kabyle farm. The four exterior walls are windowless, all the rooms opening onto the interior court according to the way of the Mohammedan house. But here in Kabylia, instead of a flat roof is one gabled and tiled very much of the European type.

FIG. 3—A Kabyle village: small tile-roofed houses clustered on a hill top.

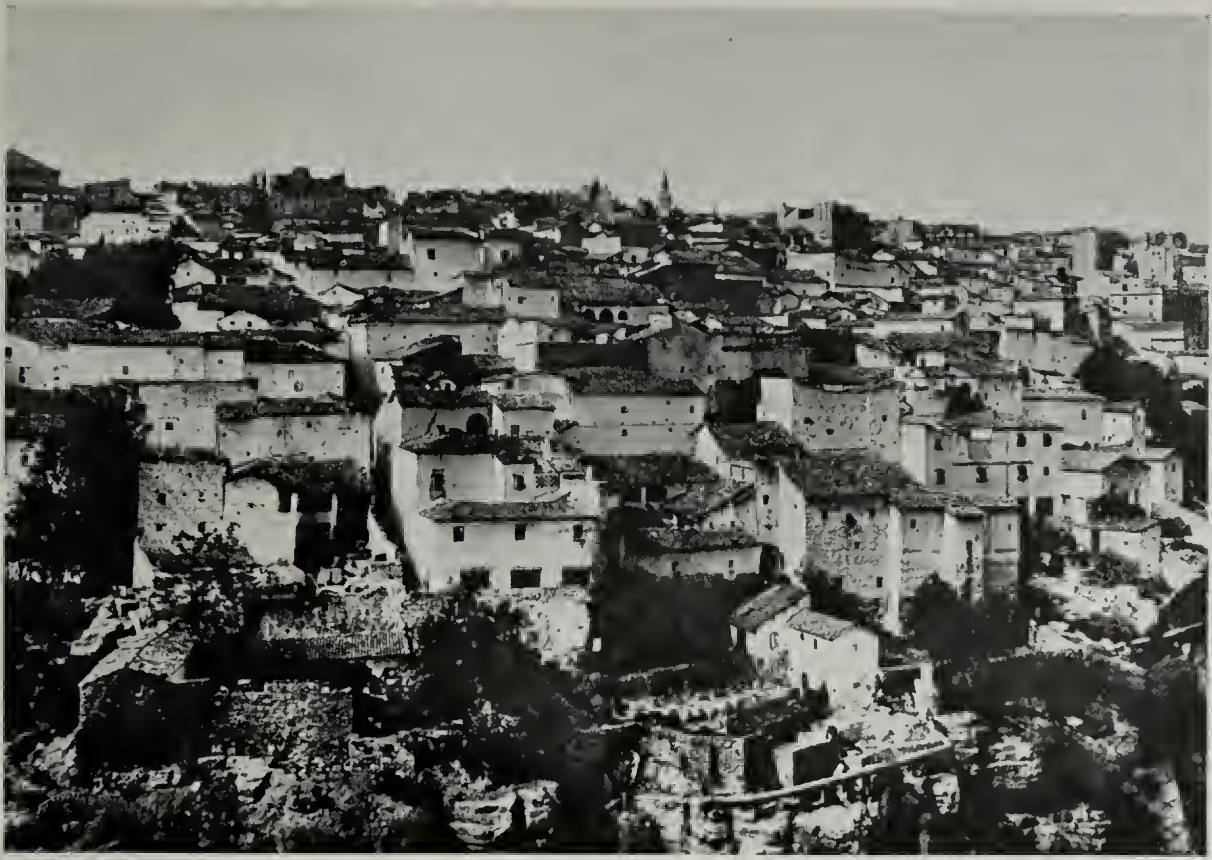

FIG. 4

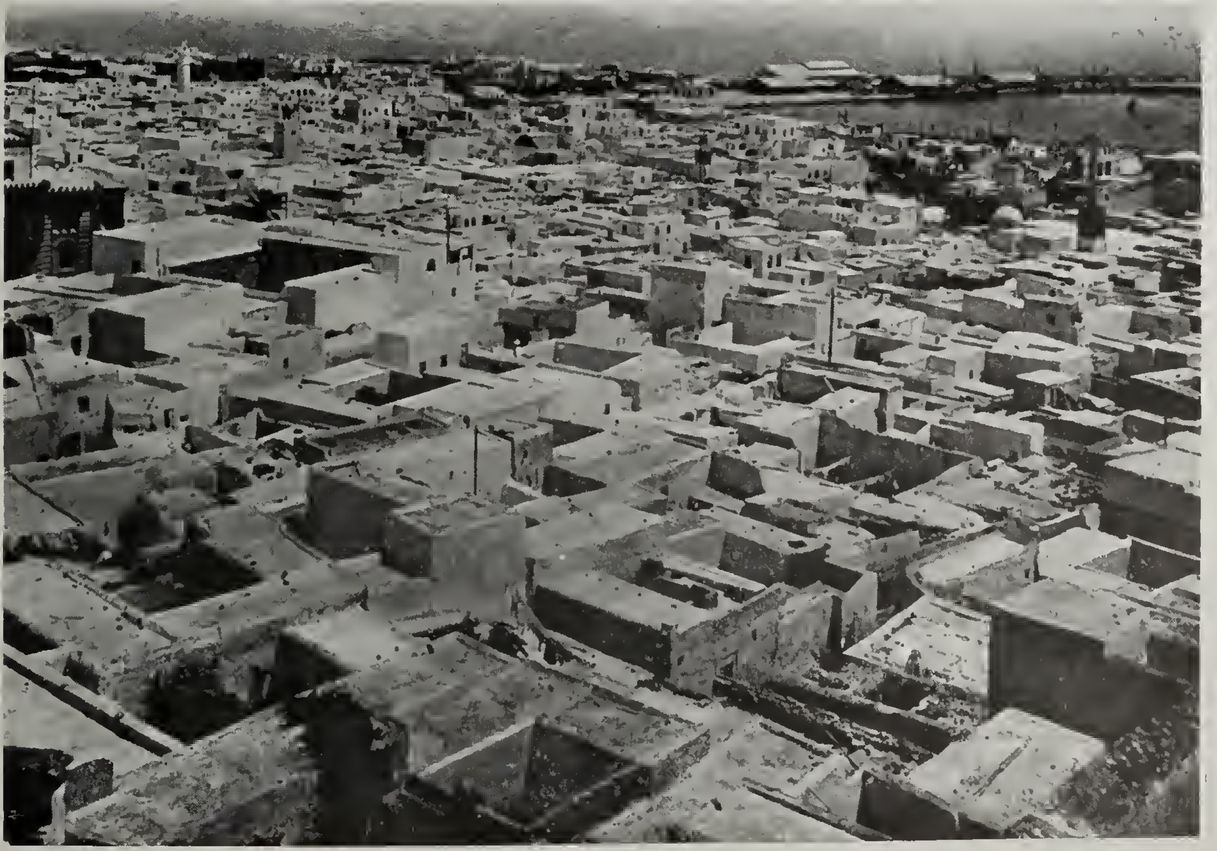

FIG. 5

FIG. 4—The town of Constantine on the border of Kabylia. As seen from above it is much like a European city of the Mediterranean seaboard.

FIG. 5—The city of Susa (Sousse) on the northeastern coast of Tunisia. Note the interior courts of the houses and the whitewashed flat-terraced roofs, the realm of the women.

The great difference between the two peoples is that the Shawiya are shepherds in accord with the nature of their more southern and more arid climate. The name "Shawiya" means shepherd. They drive their sheep along from pasture to pasture and so live much of the time under canvas, their villages remaining more or less empty for a great part of the year. A prominent feature in the Shawiya architecture is the tribal granary, a common building with many separate cells for the different families to store their corn. Somebody is appointed by the *jamā'a* to look after the stores while the owners are away. In some cases the granary could be trusted to look after itself, being high up on an inaccessible cliff (Fig. 6).

The Shawiya, however, have no connection with their neighbors, the great camel-breeding nomads who cover hundreds of miles from winter to summer pastures. For the Shawiya only shift their dwellings along a radius not exceeding a score of miles or so; from mountain top in summer to low valley and plain in winter, a movement comparable with the well-known *transhumance* as it is practiced in Italy, Spain, and southern France. Still the Shawiyas are nomads after all and have been always. Their country is the ancient Numidia, the root of which is found in the word nomad.

Shawiyas and Kabyles speak such different Berber dialects that they can not readily understand each other. Though neighbors, they belong to two different worlds, as was the case in the past between Numidia and Mauretania. On the northern slope of Aures lies Timgad, the wonderfully preserved remains of a Roman town, almost vying with Italian Pompeii in archeological glory. The whole of the Shawiyan country is scattered over with similar Roman ruins which, on the contrary, are scarce in Mauretania. Modern Kabylia, very much like ancient Mauretania, is of Algerian provinces by far the most impervious to European colonization, largely because of the passionate love of the peasant for the piece of ground he owns. In regions of nomadism like ancient Numidia the ownership of the land by peasantry is unknown, and there is plenty of room for the encroachments of colonization.

MOROCCAN BERBERS

Morocco as a whole has been closed to European investigation except during the last fifteen years; and this is particularly true of the Berber parts of the country, which are very little known. There are two main Berber provinces in Morocco, one extending along the Mediterranean coast from Tangier to the Algerian border—the so-called Rif, the other chiefly occupying the Atlas, more than one-half of Morocco. It is noteworthy that here most of the tribes still call themselves "Beraber" (singular "Berberi")—a name which, while it has been preserved outside North Africa in European languages, has quite disappeared from common use amongst natives in Algeria. The Atlas is the mightiest stronghold of Berber-speaking natives in Africa Minor.

Rif and Atlas Berbers have features in common with Kabyles and Shawiya. They too inhabit high, rugged mountains; and in Morocco as in Algeria they have succeeded through the whole of history in keeping the foreign yoke more or less away from their mountains. Kabylia has been the last achievement of French conquest in Algeria. In Morocco this same French conquest encircles the Atlas and penetrates it but deals with the more secluded parts of it in the slowest and most prudent way.[5] What difficulties Spain meets with in the Rif everybody knows. There is no doubt that the political organization of the Moroccan Berbers closely resembles that of their Algerian brothers. They are a confusion of petty tribes or clans, democratic communities, every one of them controlled by a *jamā'a*.

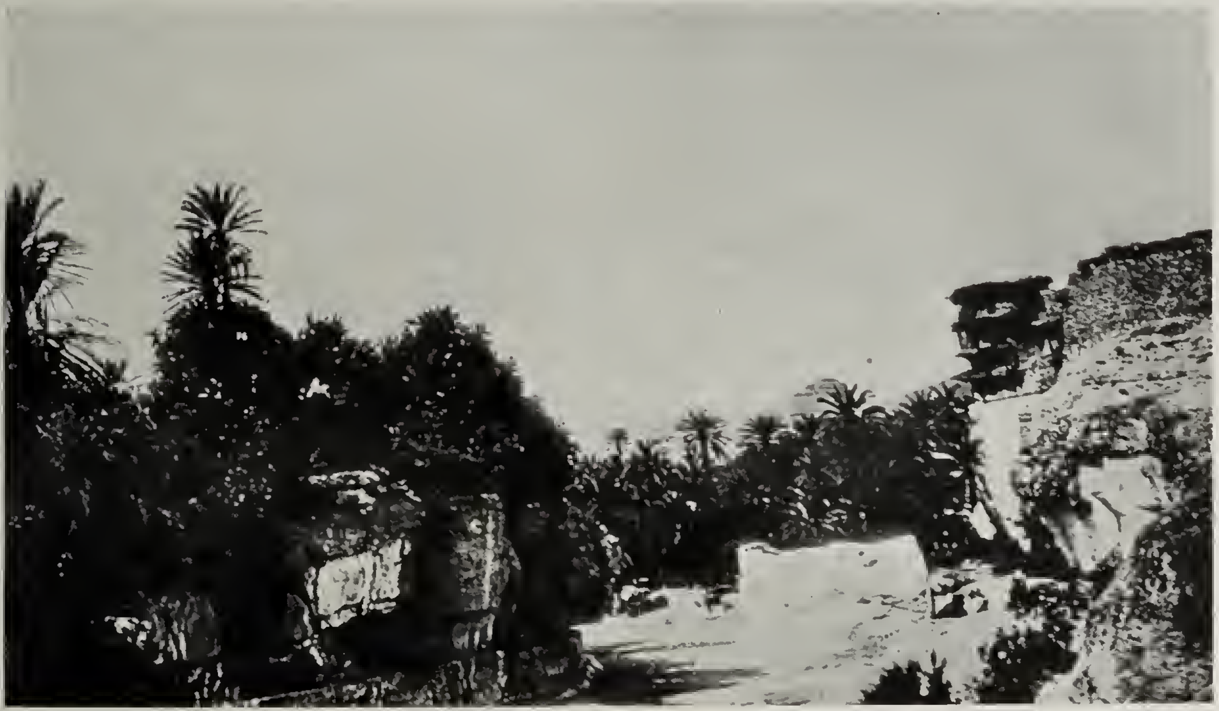

FIG. 6—Granary of the Shawiya village of Banyan in southwestern Aures. For safeguarding the stores during the lengthy absence of the seminomadic villagers the granary is placed in an inaccessible position projecting from a cliff top.

Needless to say, there is no kind of general political organization nor anything like a common national feeling among North African Berbers. Rif and Atlas have remained up to now one of the least-explored corners of the globe, because the lack of any central authority and the never-ending feuds between petty tribes have made the country impenetrable.

TUNISIA

The Arabic part of French North Africa seems at first glance rather less disconnected than the Berber sections. Actually, however, this is not the case. The several sections are no more closely linked than the Berber regions, largely from historical causes. The northeastern corner, for instance, around Tunis and Bône, owes its distinctive character to the fact that it has been the seat of the realm proper of Carthage. We have been taught at school that victorious Rome destroyed Carthage. According to history, the town was razed to the ground, its site was plowed, and salt was sown in the furrows. We do not realize that such phrases as a rule are metaphors. A great people is not so easily exterminated.

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[5] For stages of French penetration in Morocco see map accompanying "The French Penetration of Morocco," *Geogr. Rev.*, Vol. 8, 1919, pp. 56–58, and for the latest phase, "La pacification du Maroc français," *Renseign. Colon.* (*Suppl. à l'Afrique Française*), Sept., 1922, pp. 241–247.

Tunisia is dotted with what the archeologists term Neo-Punic steles, that is tombstones with Punic epitaphs dating from every period of the Roman empire, centuries after the supposed destruction of Carthage. One of the greatest Roman emperors, Septimius Severus, who ruled the empire with great efficiency at the end of the third century of our era, was a North African. He was born in Leptis Magna, one of Carthage's colonies (Tripoli). We are told by historians that he always used the Punic language in his family. St. Augustine, who died a bishop at Bône early in the fifth century, tells us how it was one of his duties to provide Punic-speaking priests or interpreters for that part of his flock which understood nothing but Punic. Procopius shows that use of the Punic language in Tunisia survived to the time of the Byzantine empire. In fact it may be said never to have died. It is a Semitic language akin to Arabic. Tunisia has been practically Arabic-speaking for 2500 years. Again the ruins of Carthage are still to be seen, not ill preserved, in a suburb of Tunis; and Tunis is practically Carthage with a modern name.

This is all significant. Tunis is the only place of French North Africa where Egyptian nationalist influence is at work. True it is that part of Africa Minor nearest to Egypt: but probably it is not quite wrong to imagine that somehow, subconsciously, old Carthage would back the young Tunisian nationalism if such a thing should come into existence, as the old Egyptian Pharaohs are not to be forgotten as a background to Egyptian nationalism. Thousands of years of glorious history are not a small matter when it comes to explaining the arousing of national feeling.

The Great Towns

According to the greatest of Arabic historians, Ibn Khaldun, it was not until so late a date as the end of the fourteenth century that the Arabic language proper was really at home in the Maghrab except in the towns. The Arabic conquest of Maghrab in the first century of Mohammedanism was achieved by a regular imperial organization, that is by the army and administration of the caliph. They wanted barracks for their soldiers and offices for their clerks; and they built some towns or used those which had been already the abode of the foregoing Byzantine and Roman empires. Berber dialects were of no use in the towns for official purposes; a regular written language, not a dialect, is needed to meet daily emergencies of government and general business. Latin, that had been used for such purposes, could only be superseded by Arabic, and it was. From the seventh to the fourteenth century, then, we must picture the towns of North Africa as islands of Arabic language and foreign civilization in a sea of wild Berber-speaking tribes.

Town life, which never was extinguished in Tunis, developed far later in Morocco. Fez was built only in the eighth, Marrakesh in the eleventh century. At that time the real heart of western Mohammedanism beat across the Strait of Gibraltar in Andalusia. After the fall of the Moorish kingdoms in Spain the refugees of Cordova and Granada brought a very important reinforcement of Arabic culture into the North African cities.

Between city and country in the Orient there is a chasm of which we have no idea. A Mohammedan town is not a thing that has grown gradually from small beginnings, as ours usually have. It has been built all at once by special order of the sultan.[6] That a city thus born should outlive the dynasty which has given it birth may happen; it did in the case of Fez or Marrakesh. But this is far from being the rule. Many instances to the contrary could be mentioned, amongst them Rabat on the Atlantic coast of Morocco. Rabat was built by Sultan Al-Mansur, the victor of Alarcos, one of the heroes of the Spanish wars. And it died with him before having been completed. For 700 years it has been standing, an immense city, within high walls, georgeous and empty, half unfinished and half ruined; a curious sight for Europeans.

Peasants living around such artificial cities cannot feel about them as our people do. The town is not their pride, their capital, a thing produced by themselves and partaking of their fortune. It reminds them of the master or even of the foe. Country and town may exchange products; they scarcely mix their blood, they live apart. Up to the coming of the French the town gates had to be closed at night; a kind of very dangerous no-man's land running between them.

Such cities, isolated for many centuries, have no intercourse, no common feeling or policy with the other large cities. The two chief towns of the Maghrab, Fez and Tunis, are different worlds.

Zenata and Bedouins

Had the towns remained all through history the only centers of diffusion for the Arabic language, it would probably not have been diffused at all. The most efficient teachers of Arabic in the Maghrab have been the Arabic Bedouins.

Their coming was a second Arabic invasion, many centuries after the first and very different from it. The Bedouins were not regular soldiers and officials, they were wandering nomadic tribes, complete families with wives and children included. It was colonization following conquest. It is a long way from Arabia to Maghrab, with serious intervening obstacles, the Red Sea, Egypt, and the hardships and dangers of the Sahara. The Bedouins were centuries coming along that way, but they arrived at last. They appeared first in Africa Minor in the twelfth century; and they spread out all over the country in the thirteenth and fourteenth. They brought destruction along with them and are chiefly responsible for the impoverishment and downfall of Maghrab.

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[6] Jules Blache: Modes of Life in the Moroccan Countryside, *Geogr. Rev.*, Vol. 11, 1921, pp. 477–502; reference on pp. 487–488.

They spoke rough Arabic dialects very different from the language of the towns-people, by whom they were both hated and despised. But they made themselves very useful to the sultans, who wanted strong men as mercenary soldiers, and flourished in consequence.

Their chief supporters were the Berber-speaking nomadic tribes, the bulk of whom are called Zenata. Having to choose between the other Berbers, those who lead a sedentary life, on one side, and the nomadic foreigners, on the other, they put themselves on the side of the foreigners. The loathing of nomads for sedentaries goes far deeper than any feeling of kinship. Bedouin colonists seem to have been few in number; and very likely in the veins of an average Arabic-speaking nomad there runs more Zenata blood than Arabic. The fact is that in Africa Minor every real nomad, of the camel-breeding kind, speaks Arabic and boasts of being an Arab.

The Bedouins have been supreme in the flat country, everywhere where cavalry can spread itself. But they never could do anything in the mountains against the infantry of the sedentary peasant.

They came into Africa Minor at the great gate of Biskra, a deep and broad cut through the Saharan Atlas, whence they spread themselves all along the high plateau. Further on in a westerly direction they came to the gap of flat country between Rif and Atlas (couloir of Taza) at one end of which lies the Algerian town of Tlemsen, at the other the Moroccan city of Fez. From there they covered the whole expanse of flat country bordering the ocean.

This is the key to the language map. It explains why both Arabic- and Berber-speaking natives are broken up in disconnected patches to a considerable extent in accord with the geographical distribution of mountainous and open country.

Architecture

The duality found in languages in French North Africa is found too in the architecture of dwellings. Every house is adjusted more or less to the individual that dwells in it; snails and oysters do not use shells of the same pattern. The people in Africa Minor use two kinds of roofs. One is the kind that Europeans are accustomed to, with a gable, a single or double slope, and a covering of tiles. The other is a terrace, generally whitewashed, such as everybody remembers having seen in pictures of Oriental towns.

The roofs in Kabyle villages are of the first kind, and so are they in a few little towns like Constantine, which is very near to Kabylia. At first glance one is reminded of Spanish, Italian, or southern French landscapes.

Most towns, especially the big cities, Tunis, Fez, Marrakesh, have the oriental terraced roofs, and in outward appearance they are much like any city in Egypt, Palestine, and Mesopotamia.

It may be objected that people build their roofs according to opportunity and climate; they build sloping roofs in the mountains where heavy snows and rains are apt to fall, terraced roofs in the low open country with a warm, sunny, and dry climate.

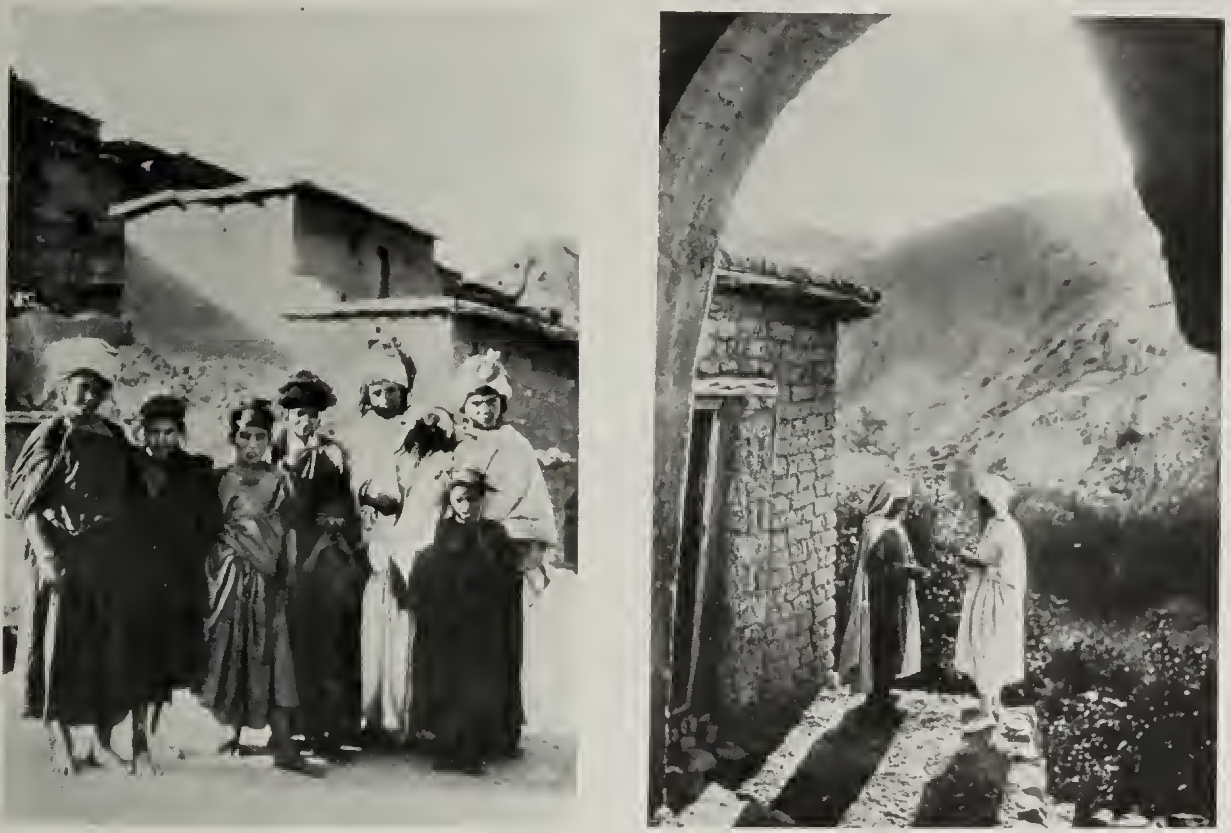

FIG 7

FIG. 8

FIGS. 7 and 8—Shawiya inhabitants of the Aures and their dwellings (village of M'naa). Note the flat roofs. They fill no social need as in the Arab regions (compare Fig. 5) but are a positive inconvenience during the time of winter snowfall. They bespeak the penetration of Oriental influences.

However, Constantine and Tlemsen lie about at the same altitude above sea level and do not differ greatly in average snowfall. Now Constantine is a typical tile-roofed town and Tlemsen a not less typical flat-roofed town. But, while Constantine has been more in touch historically with Kabylia, Tlemsen has been associated with Zenata and Arabs.

Two little towns lying not far from each other or from the sea, Ténès between Algiers and Oran, and Mazouna inland, have different roofs. The town with tile roofs is Ténès, and there is no mystery about the explanation. It was founded after the downfall of the Moorish kingdoms in Spain by refugees from Andalusia, and they brought with them the kind of European roof to which they were accustomed.

The most interesting case is probably the instance of the Shawiya dwellings. The villages in the Aures Mountains are rather puzzling at first glance.

The manner in which the little houses cluster on the hill tops reminds one of the Kabyle villages; but every house has a terraced roof. The puzzle only increases if you speak with the Shawiya. They complain about their terraces, a great nuisance in winter, because the snow has to be swept out carefully after every storm, or the adobe roof would fall in. Why then do they not use another kind of roof, one better adapted to the climate? They would not know how to do it; they are just building along in the old lines, according to time-honored tribal usage. In the Shawiya country, where nomadism and sedentary life have vied with each other, the architecture bears testimony of both influences, the European and the Oriental.

This difference in the house roofs is not such a small matter as it may look at first glance. It is, in fact, of paramount importance from a social point of view. In Oriental towns where the family lives up to the Mohammedan ideal, every house turns to the street a blind wall without windows; all the apertures of the rooms look inside the house upon the central yard, the *patio* of the Spaniards. This prison-like aspect of the house is in accordance with the secluded life of the harem. Mohammedan women live indoors, and the street is for them practically forbidden ground. But it is impossible to restrict them to the *patio*, to spend all their life confined to a courtyard, almost as deep, narrow, dark, and damp as a well. The flat roofs are for the women: men are forbidden to tread them as strictly as women are forbidden to tread the streets.

From the top of a minaret you look at the world of terraces spreading itself below you. All the terraces appear pretty much at the same level, and many bridges have been carried from block to block. This is why Oriental towns have far more *impasses* than streets, and why subway-like *passages couverts* are so numerous. The terraces have been built in such a way that it is easy to walk along on them from one end of the town to another. This is the realm of the women. Here they get their share not only of sunshine, but, what is no less important, of social intercourse. From terrace to terrace they exchange greetings, visits, abuse, and gossip; and here they enjoy life generally. Without the terraced roofs real Mohammedan family life would be impossible. In towns with tile roofs you may be sure that the seclusion of women has been more or less disregarded.

A brief study of architecture leads us to the same conclusion as does the language map.[7] In French North Africa two different worlds, west and east, are interwoven. This is what makes the distinctive character of Maghrab; it has two souls, and it has never known exactly to which civilization it belonged, eastern or western.

MZABITE AND JEW

This essential duality prevented Maghrab from forming a political body. But as a consequence, Maghrab has been further subdivided—into so many parts that it would be foolish to try to count them. One or two instances may be given here.

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[7] Cf. map (Pl. VII) accompanying Augustin Bernard and Edmond Doutté: L'habitation rurale des indigènes de l'Algérie, *Ann. de Géogr.*, Vol. 26, 1917, pp. 219–228.

The most peculiar tribe in Algeria is perhaps the Mzabites. Mzab is far away in the desert (see map, Fig. 1). Not only is the surrounding country most uninviting, but in the very oasis, under the shadow of palm trees, the only way of getting water is to draw it from wells 180 feet deep. In such a place the annual expenditures are far greater than the incomes; every onion costs ten times what it may be worth. Mzab is really the fancy garden of rich business men.

In every Algerian town you will see Mzabite shops, where everything is sold, from vegetables to rugs or dry goods. Those shops, not the Mzab proper, are the real home of the Mzabite. Mzab is the place where every Mzabite business man may go on a vacation once in two or three years for a few weeks; it is the stronghold where he may bury money or hide precious religious books; a place where he gets his children educated. Tomorrow they may shift this stronghold and garden to another spot, as they have done in the past more than once. They are not attached to any particular geographical location. The very name we know them by, Mzabite, is only a popular appellation and not a topographical name. They call themselves Ibadits, which is the name of a well-known Mohammedan sect, pretty much akin to our Christian Puritans. By strict intermarriage for ten centuries they have developed into a race; they resemble one another physically and can be recognized at once when seen in the street. But in their own eyes they do not consider themselves as a race any more than they claim to belong to a geographical country. They just are Ibadits. Other Ibadits live in far-away corners of the Mohammedan community; some at Muscat in southeastern Arabia; some at Zanzibar. With these the Algerian Mzabites feel themselves connected by a brotherly link. But they loathe to the utmost their neighbors, the other Algerian Mohammedans.

The Mzabites are one of the numerous "nations" making up Africa Minor. This kind of nation, so strange in our European eyes, is a common feature in Eastern political and social life. The Parsis in India, the Armenians in the Turkish empire, and above all the Jews everywhere are exactly of the same national pattern as the Algerian Mzabites. They are a nation without a country, geographically speaking, scattered about over a wide expanse, and yet a nation with the most exclusive and passionate national spirit. Religious feeling is theoretically the only link, even if it has led practically to racial unity. And, curious to say, in every case, acute understanding of money matters and a shrewd feeling for business have become the leading characteristics of the community.

The Jews also are to be found in Maghrab; they, too, are one and not the least important nation amongst the medley of native races in French North Africa. Up to now they are the only race that has gone entirely over to the French. They have become French citizens and have discarded Arabic as the language of instruction in the schools.

THE HISTORICAL GEOGRAPHY OF EARLY JAPAN *

By Carl Whiting Bishop
Smithsonian Institution

It is matter for congratulation, in view of the steadily growing interest in the question, that the accumulation of evidence from various sources begins at length to throw some definite light on the origin of the Japanese people. Much confusion has existed on this subject hitherto, owing mainly to the fact that the work of investigators along different lines had been insufficiently collated and correlated, while at the same time the methods of interpretation were not altogether free from fault. A solution of the problem is not to be attained by a study of conditions and events in the Japanese islands alone. The same causes which have brought about the various contacts, friendly or hostile, between Japan on the one hand and eastern Siberia, Korea, Shantung, and the southeastern Chinese littoral on the other, during the past three decades, have been at work without intermission ever since the first settlement of man in this portion of the globe. The developments, political, social, economic, whose course we have followed with such close attention during the past few years are but the latest phase of a process whose beginnings are lost in the darkness of prehistoric time. It is thither that we must trace them if we would arrive at anything like a right comprehension of the foundation upon which rests the national life of Japan.

First Contemporary Accounts of the Japanese People

Derived without exception from Chinese sources[1] are our first contemporary accounts of the Japanese people, two thousand years ago. The region at that time occupied by their various tribes embraced not what we think of as the Japanese islands, but only their westernmost portions, together apparently with the southern end of the Korean peninsula and the large island known to us as Quelpart, lying out in the Yellow Sea. As will be seen, it was not until the seventh century of our era that the Japanese became in reality wholly an island people. Hence insularity was far from being the geographical factor of most weight in their early development. Of vastly greater significance was the fact that during their formative period they were in such close touch with the various civilized communities of the continent.

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* Read at the Joint Meeting of the Association of American Geographers and the American Geographical Society, April, 1922.

[1] See for an account of these, James Murdoch: A History of Japan, Yokohama, 1910, Vol. 1, pp. 31 *et seq.* For accounts of what the Chinese writers have to say regarding the early Japanese, see E. H. Parker: Ma Twan-Lin's Account of Japan up to A. D. 1200, *Trans. Asiatic Soc. of Japan*, Vol. 22, 1894, pp. 35–68; also, Albert Tschepe: Japans Beziehungen zu China seit den ältesten Zeiten bis zum Jahre 1600, Yenchow-fu, 1907.

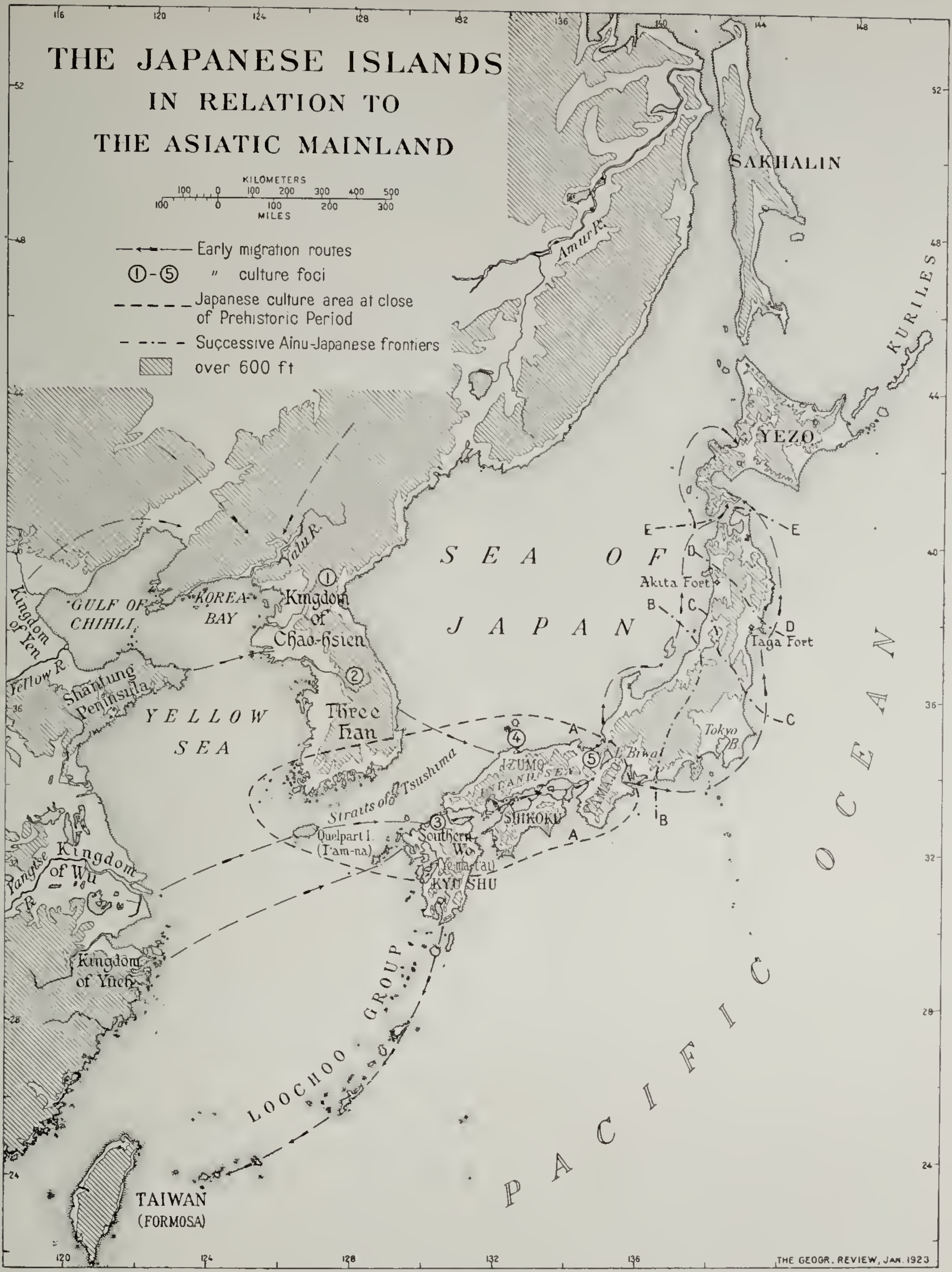

FIG. 1—Map to illustrate geographical relationships in early Japanese history. Numbers indicate the main cultural foci: 1, northern Korea (the kingdom of Chao-hsien is here shown in its later stages, earlier it extended across the Yalu basin); 2, southern Korea; 3, Kyushu; 4, Izumo; 5, Yamato. Letters have reference to successive Ainu frontiers. The conquest and absorption of the Ainu had pushed the Yamato frontier as far eastward as the Lake Biwa region (A) before the close of the prehistoric period. The line B—B represents the next great advance, just at the dawn of the historical period, and C—C the frontier as it existed about the time of the loss of the continental possessions of the Yamato. The line D—D was reached by the Japanese about the beginning of the eighth century, and the occupation of the main island may be regarded as completed, in its broad outlines, by the close of the tenth century. Scale of map approximately 1: 22,500,000.

Peopling of the Japanese Islands

The effect of winds and currents was also much slighter than is often claimed. The sail was still quite unknown in Far Eastern waters in those prehistoric ages when the peopling of the Japanese islands was going on, so that there was no way in which the monsoons could exert any particular influence upon the course of migration.[2] And the southern element, so clearly apparent in both the people and their culture, came not from those equatorial regions whence flows the Japan Current but from a direction at right angles to it, the seaboard of China, in days before Chinese civilization had yet reached the coast. Those who speak of a Polynesian or a Malayan strain in the Japanese ignore entirely the historical aspect of the problem; the great Polynesian diffusion did not take place until long after the emergence of the Japanese people, while the Malays do not appear on the scene until later still. The real effect of the southwest monsoon and the warm tropical current has been a climatic one. To them it has been due that the type of culture developed during prehistoric times in the southeastern coast lands of the continent could find in the southern and western portions of the Japanese archipelago those conditions of warmth and humidity requisite to its survival and further development.

Of Paleolithic man in Japan there has so far appeared absolutely no trace, and it is altogether likely that the islands, together with the east of Asia generally, remained unpeopled until geologically very recent times.

The earliest inhabitants of Japan of whom we have any knowledge were the ancestors of the existing Ainu of Yezo (Hokkaido), who at one time occupied the entire archipelago, remaining in undisturbed possession during a period which may well have extended over several thousand years.

At length, probably far back in the first millennium before Christ, if not indeed earlier still, there began a fresh invasion of the Japanese islands, this time by peoples belonging to various branches of the great Mongoloid stock, from eastern Siberia to the south Chinese littoral, with probably in the latter case a slight Negrito admixture. The result of the minglings in varying proportions between these newcomers and their predecessors forms to this day the great bulk of the Japanese population.[3]

Finally, commencing not long before our era and recurring at intervals for several centuries, there was a series of immigrations of northern Mongoloids—Chinese and Koreans in the historical sense—whose influence, physical but more particularly cultural, has been largely confined to the upper strata of Japanese society.

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[2] On the late introduction of the sail in Japanese waters, see B. H. Chamberlain (transl.): Ko-ji-ki, or Records of Ancient Matters, *Trans. Asiatic Soc. of Japan*, Vol. 10, 1882, Supplement; reference in Introduction, p. xxv; H. A. C. Bonar: On Maritime Enterprise in Japan, *ibid.*, Vol. 15, 1887, pp. 103–125; reference on pp. 107 and 111; W. G. Aston: An Ancient Japanese Classic (The *Tosa Nikki*, or Tosa Diary), *ibid.*, Vol. 3, Part II, Jan.–June, 1875, pp. 121–130; reference on p. 124.

[3] Regarding this question of the composition of the Japanese people, see the following: K. Hasebe: Study upon the Human Bones found at Kô in the Second Excavation, *Rept. upon Archaeol. Research in the Dept. of Literature, Kyoto Imperial University*, Vol. 4, 1919–1920; *idem:* The Excavation of the Shell-Mound at Tsukumo, a Neolithic Cemetery in the Province of Bitchû, *ibid.*, Vol. 5, 1919–1920; H. Matsumoto: Notes on the Stone Age People of Japan, *Amer. Anthropologist*, Vol. 23 (N. S.), 1921, pp. 50–76; Katsuro Hara: An Introduction to the History of Japan, N. Y., 1920, pp. 48 *et seq.;* H. ten Kate: Notes détachées sur les Japonais, *Bull. et Mémoires Soc. d'Anthropol. de Paris*, Ser. 5, Vol. 9, 1908, pp. 178–195; E. Baelz: Prehistoric Japan, *Ann. Rept. Smithsonian Instn. for 1907*, pp. 523–547; Frank Brinkley: Primeval Japanese, *ibid.*, 1903, pp. 793–804.

The Ancestral Ainu

The first of these races, that of the ancestral Ainu, seems to have reached the Japanese islands in at least three successive waves, perhaps separated by long intervals of time.[4] Recent studies have shown that it was divided into several subtypes, at least two of which appear to survive in the existing Ainu. That the language of this ancient race was essentially that still spoken by its surviving representatives in the island of Yezo is indicated by the fact that place names occur all over the Japanese islands, from end to end, and possibly even in the Loochoo group, which can only be explained in terms of Ainu speech.[5]

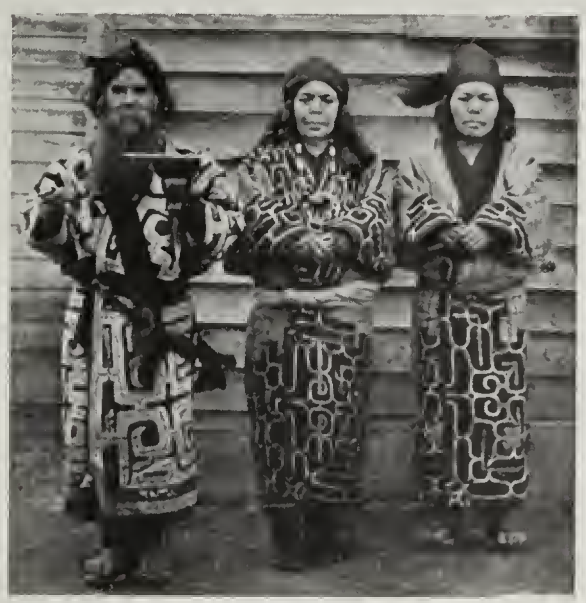

Fig. 2—Ainu man and women at Piratori, island of Yezo; the man has ceremonial headdress and moustache lifter. The designs on the clothing are distinctive of this race.

Regarding the origin of this primitive people we are still wholly in the dark. Some have seen in them a kinship to the prehistoric European race known as that of Furfooz-Grenelle. Language tells us nothing; for, aside from loan words from neighboring tongues, the Ainu speech stands entirely isolated.[6] Physically there is no evidence of connection with the Mongoloid family, save for such interminglings as have taken place in relatively recent times. Many investigators have regarded the Amur region of Siberia as that from which this ancient race entered Japan. The fact should not be overlooked, however, that individuals of Ainu type are by no means unknown in Korea, while a possible relationship has also been suggested between the Ainu and the Pre-Dravidian tribes of India, or even with the natives of Australia.

Perhaps we may say, in the light of all the available evidence, that the few thousand Ainu still remaining, as well as the related stocks inhabiting Japan in days prior to the advent of Mongoloid man, represent an extremely ancient generalized human type from which more than one of the wavy haired and heavily bearded races of Europe and southern Asia have been specialized.[7]

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[4] See regarding these ancestral Ainu, in addition to the papers by Hasebe and Matsumoto, already cited, N. G. Munro: Prehistoric Japan, Yokohama, 1911, pp. 37–292 and *passim;* also Hara, *op. cit.*, pp. 31 *et seq.*

[5] Regarding Ainu place names in Japan, see B. H. Chamberlain: The Language, Mythology, and Geographical Nomenclature of Japan Viewed in the Light of Ainu Studies, Tokyo, 1887; also, Romyn Hitchcock: The Ainos of Yezo, Japan, *Rept. U. S. Natl. Museum for the Year Ending June 30, 1890*, pp. 429–502; reference on p. 434.

[6] Berthold Laufer: The Vigesimal and Decimal Systems in the Ainu Numerals: With Some Remarks on Ainu Phonology, *Journ. Amer. Oriental Soc.*, Vol. 37, 1917, pp. 192–208; reference on p. 205.

Of the culture of the ancestral Ainu, thanks to the somewhat extensive excavations of the past few years, we know considerably more than we do of their origin. They were already in the Neolithic stage as far back as they have been traced. They manufactured polished stone implements and a highly interesting and very ornate type of pottery, made, of course, without the aid of the potter's wheel. They seem to have derived part of their subsistence from the cultivation of millet, although doubtless dependent mainly upon hunting, fishing, and various wild vegetable products. Of domestic animals, with the exception of the dog, they were entirely ignorant. In summer they lived in rough huts and in winter in earth-covered lodges constructed either partly or wholly underground. Dwelling mainly on the coast and knowing how to make large dugout canoes, they were fearless seafarers, hunting the whale as well as smaller marine animals and, in later times, meeting the fleets of war boats of the invading Japanese in fiercely contested naval combats from which the newcomers by no means always emerged victorious.

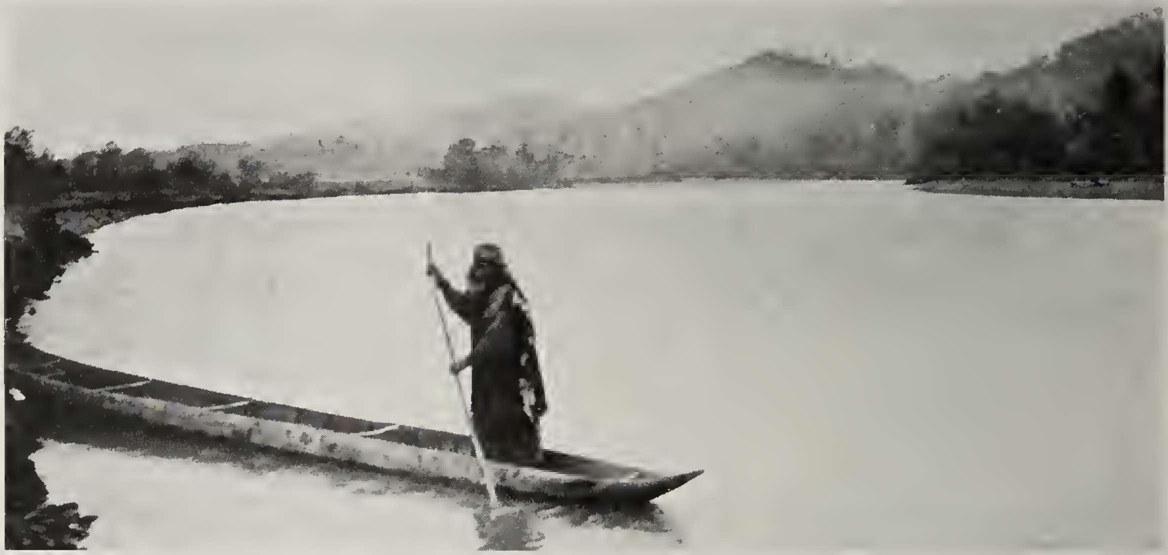

Fig. 3—Old Ainu man operating canoe ferry in interior of island of Yezo. The Ainu, in common with other North Pacific peoples both of Asia and of America, were expert canoemen.

Of their social, political, and military organization we can infer but little. It seems clear, however, that in these respects they were scarcely if at all behind the earlier comers of Mongolian extraction who settled among them; for they were able to keep the latter pretty closely confined to the extreme western portions of the Japanese archipelago for many centuries. It was simply and solely the stubborn geographical fact that the Mongoloids always had free access to the civilizing influences emanating from the continent, while the Ainu had not, that inevitably swayed the balance in favor of the former, and in the long run sealed the fate of the aborigines as a distinct ethnic entity.

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[7] On the classification of the Ainu, see George Montandon: Notice préliminaire sur les Aïnou, *Archives Suisses d'Anthropologie Générale*, Vol. 4, No. 3, 1921, pp. 233–246; reference on p. 242; also, A. F. Chamberlain: The Japanese Race, *Journ. of Race Devel.*, Vol. 3, 1912–1913, pp. 176–187; reference on p. 182.

EARLY MONGOLOID INVASIONS

We know from various sources that southeastern Asia prior to the rise of the Chinese civilization was occupied by a race of Mongoloid stock, akin to the existing peoples of Indo-China and Indonesia, whose original culture, of a generalized Neolithic type, had taken on a distinctly southern and maritime aspect. That it was in contact, however, with more northern regions is shown by the occurrence both in Shantung and in Japan of the grooved stone ax, a type of implement found likewise in the North Pacific area.[8] The discovery again both in China and in Japan of the peculiarly shaped objects known in the latter country as *seki-bo*, or "stone clubs," also indicates a former widespread community of culture, extending in this instance even to the Ainu.

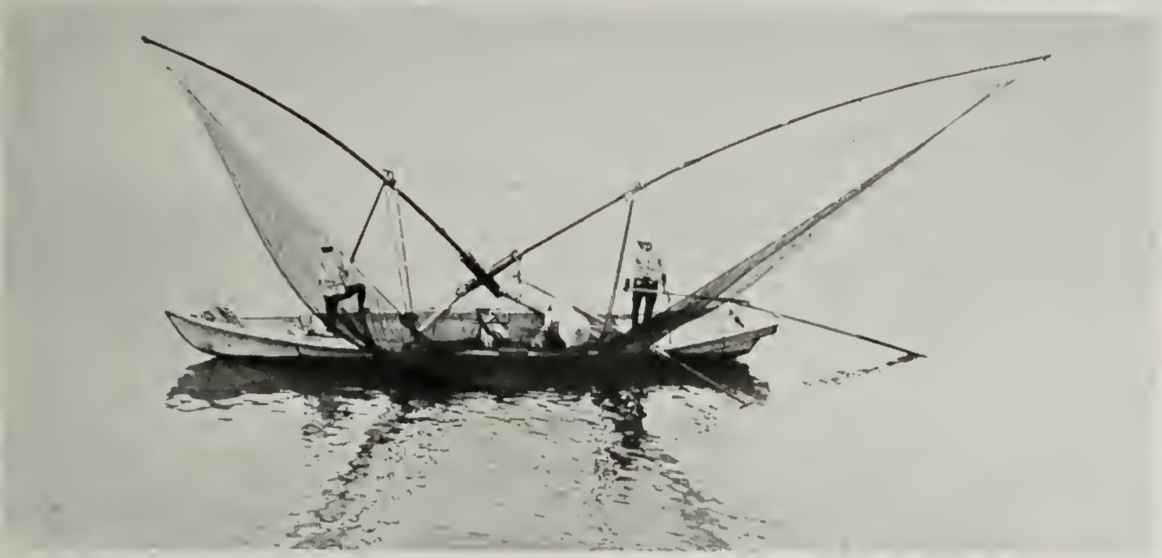

FIG. 4—Type of Japanese fishing with aid of large dip net, introduced from southern or central China.

Socially, this southeastern Asiatic culture seems to have been characterized by descent in the female line, by seasonal mating festivals, and, at least in the ruling families, by brother-and-sister marriage.[9] The economic life, based primarily upon fishing, with doubtless some hunting, had been enriched before the close of the Neolithic period by the acquisition of various food plants, cultivated with the aid of the hoe alone. Among methods of bodily ornamentation were blackening of the teeth and tattooing. But little clothing was worn, save in cold weather; and the habit of promiscuous bathing, with a total indifference to bodily exposure, was general. No domestic animals other than the dog and the fowl appear to have been known. In the absence of metals, great use was made of bamboo, although stone and bone were also utilized in various ways. There is some reason to believe that the spear rather than the bow was the weapon most commonly in use. As befitted a culture essentially amphibious in type, large canoes were made, each usually ornamented at the bow with the carved head of a crocodile or an alligator.[10] The religion was one of nature worship, with a strongly anthropomorphic trend and a highly interesting body of folklore. Possibly as a result of the matrilineal organization of society, the principle of reproduction and growth received special veneration, and goddesses were particularly in evidence. Ancestor worship, where found at all in this area, appears only late and then as a consequence of the introduction, among the higher classes, of a patriarchal type of family in imitation of the Chinese. Practically all these culture elements are traceable in Japan, some of them surviving to this day, while others have disappeared only in comparatively recent times.

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[8] On this question of the grooved ax, see Berthold Laufer: Jade: A Study in Chinese Archaeology and Religion, *Field Museum of Nat. Hist. Publ. 154* (*Anthropol. Ser., Vol. 10*), Chicago, 1912, pp. 50 *et seq.*

[9] For its former existence among the Japanese, see B. H. Chamberlain: *Ko-ji-ki*, Intro., pp. xxxviii and xlv; W. G. Aston: Shinto (The Way of the Gods), London, 1905, p. 91.

From the end of the promontory of Shantung to the corresponding projection on the opposite coast of Korea it is only a trifle over a hundred miles—a stretch of sea easily negotiable by such inveterate sea rovers as were the Neolithic coast peoples of eastern and southeastern Asia. The strait between Korea and Japan is almost exactly the same distance across; and here there are islands where early voyagers could conveniently break their journey. It seems likely for a number of reasons that the colonization of Japan by the Mongoloid peoples of the neighboring continent took place largely by way of Korea. Probably, however, even within the Neolithic period a good deal of migration went on also directly across the Yellow Sea. The distance here is something under five hundred miles, with the lofty island peak of Quelpart, already mentioned, forming a natural stepping-stone.

This migration of peoples into Japan, to be properly understood, must be viewed as a phase of that great ethnic movement which brought about the colonization by the so-called yellow-brown races of so much of the enormous area extending from Japan on the east to Madagascar on the west. When this process began, we are as yet unable to say; but it seems not unlikely that one of the contributing factors was the pressure generated by the slow expansion coastward of the Chinese in the second and first milleniums before Christ. The disturbances set up, for example, by the Chou conquest of the Yellow River basin, about the eleventh century before our era, were felt far and wide and must have led to much shifting of peoples both by land and by sea.[11] Again, when the "barbarian" kingdom of Yüeh, corresponding roughly to the modern Chinese province of Chekiang, overthrew the rival state of Wu, in the Yangtze embouchure region, in 473 B. C., the ruling class of the latter are said to have made their escape to certain islands to the eastward, which can hardly have been other than the western portion of the Japanese group.[12]

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[10] A crocodile (*Crocodilus porosus*, or "Estuarine crocodile") seems to have been found anciently all along the southeastern Chinese coast at least as far north as the Yangtze delta, although now practically exterminated; cf. Arthur Stanley: The Collection of Chinese Reptiles in the Shanghai Museum, *Journ. North-China Branch of the Royal Asiatic Soc.*, Vol. 45, 1914, pp. 21–31, reference on p. 23.

A true alligator (*Alligator sinensis*), smaller than the American forms and rarely exceeding six or seven feet in length, still occurs in the Yangtze, although it is by no means common; cf. A. A. Fauvel: Alligators in China, *ibid.*, Vol. 13 (N. S.), 1878, pp. 1–36 f.

[11] Compare C. W. Bishop: The Geographical Factor in the Development of Chinese Civilization, *Geogr. Rev.*, Vol. 12, 1922, pp. 19–41.

The earliest distinct reference to Japan in the Chinese writings, however, is one in the work known as the *Shan Hai Ching*, to the effect that the northern and southern Wo are tributary to Yen, a Chinese feudal kingdom at the head of the Gulf of Chihli.[13] Inasmuch as Yen ceased to exist as an independent state in the year 226 B. C., this notice carries us back at least as far as the middle of the third century before our era, and possibly even farther still, since we know that Yen had been sending out exploring expeditions by sea as early as the reign of King Wei (378–343 B. C.).[14] We need not infer, however, that an actual conquest by Yen of any part of the Japanese islands ever took place. As is well known, it was long an official convention in China that all outsiders resorting to her for purposes of trade came to her as "tribute bearers." It may therefore be fairly concluded from the passage in the *Shan Hai Ching* that the two Wo peoples were in the habit of sending trading parties to Yen which had the cognizance of its government in days when foreign commerce was kept as far as possible a close state monopoly.

Precisely where the two Wo are to be sought, it is impossible to say. Perhaps the northern branch inhabited the lower extremity of the Korean peninsula;[15] or, on the other hand, they may both have dwelt in western Japan. That the southern, or "Great," Wo were located in Kyushu seems quite clear. For another name applied to their country by Chinese writers is that of Ye-ma-t'ai. This region, we are told, lay to the south of Korea—somewhere, that is to say, in the island of Kyushu—and contained a hundred petty kingdoms, all subject to the Ta Wo Wang, or great king of the Wo. It is further described as a maritime region with a late Stone Age culture, lying nearly due east of what is now the Chinese province of Chekiang and enjoying so mild a climate that vegetables were grown both winter and summer.[16]

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[12] Albert Tschepe: Histoire du royaume de Ou (1122-473 av. J.-C.), *Variétés Sinologiques*, No. 10, Shanghai, 1896, p. 156, quoting from the *T'ung-chien K'ang-mu.* Early Chinese writers describe an enchanted isle in the Eastern Sea where the customs are like those of the people of Wu; see E. H. Parker: Early Japanese History, *The China Review*, Vol. 18, 1889–1890, pp. 212–248; reference on p. 214.

[13] W. G. Aston: Early Japanese History, *Trans. Asiatic Soc. of Japan*, Vol. 16, 1888–1889, pp. 39–75; reference on p. 40 and in note 5. While the date of composition of the *Shan Hai Ching* has not yet been settled beyond dispute, the weight of evidence points toward the third or second century before Christ, although it undoubtedly contains much earlier elements.

[14] For the maritime explorations of Yen, see Édouard Chavannes, Mémoires Historiques de Se-ma Ts'ien (5 vols., Paris, 1895–1905), Vol. 3, pp. 436 *et seq.;* on the conquest of Yen by Ch'in Shih Hwang-ti in B. C. 226, *ibid.*, Vol. 4, p. 150. Inasmuch as the state archives of Yen, like those of practically all the rest of the ancient Chinese feudal states, have been lost, we know nothing regarding the details of her maritime explorations.

[15] Cf. E. H. Parker: China: Her History, Diplomacy, and Commerce, from the Earliest Times to the Present Day, 2nd edit., London, 1917, p. 21.

[16] H. Maspéro: *Bull. École Française d'Extrême Orient*, Vol. 9, 1909, pp. 593 *et seq.;* N. Peri, *ibid.*, Vol. 10, 1910, p. 715, note 1; C. E. Maitre: La littérature historique du Japon des origines aux Ashikaga, *ibid.*, Vol. 10, 1910, pp. 564–596; reference on p. 580, note 1.

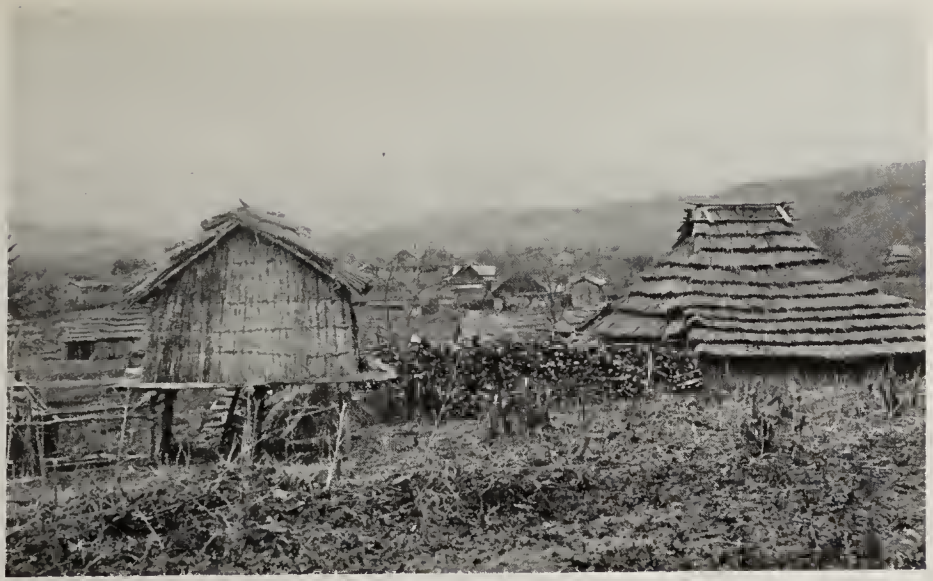

FIG. 5

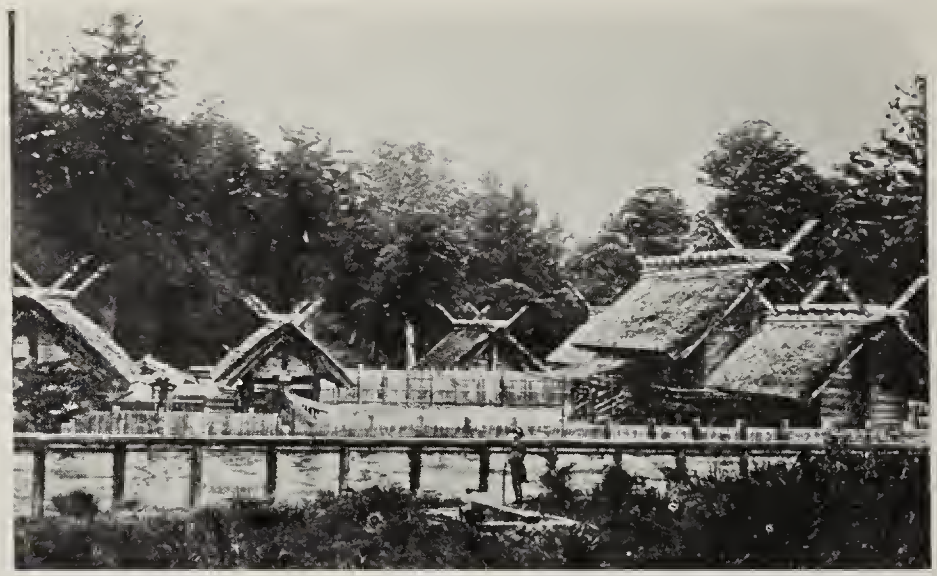

FIG. 7

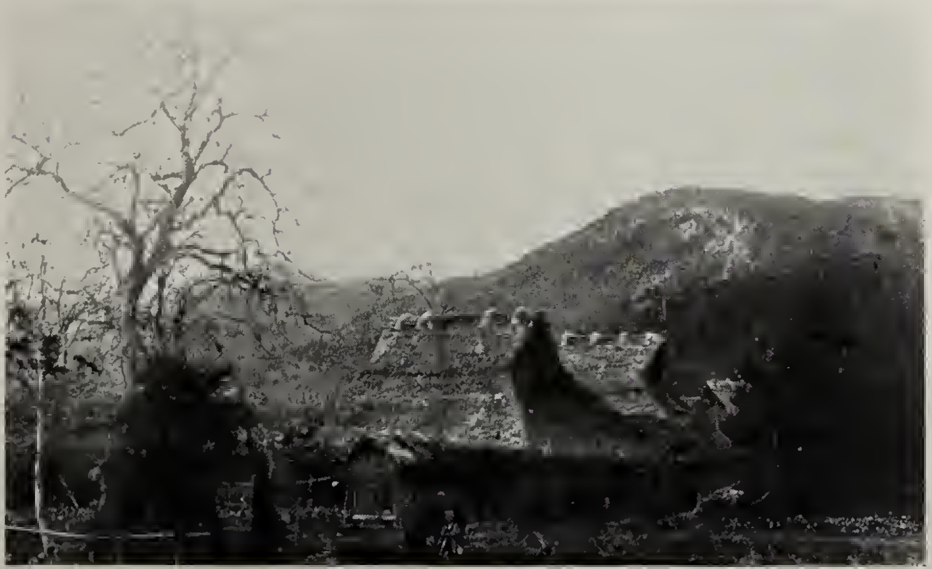

FIG. 6

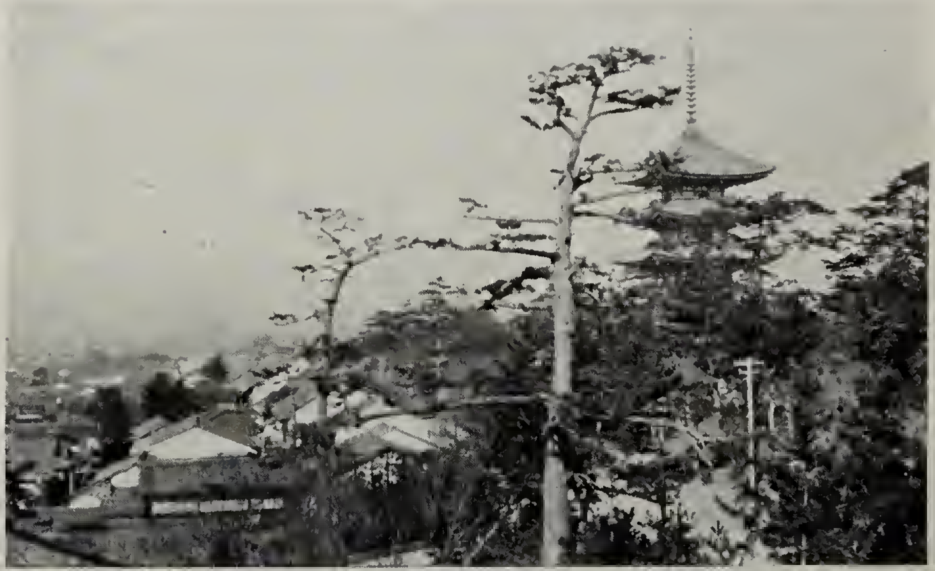

FIG. 8

FIG. 5—Ainu village. Note piles of firewood provided against the bitterly cold winter. The Ainu formerly used earth-covered dugouts as cold-weather residences, while their storehouses elevated on piles point to contact with southern insular peoples.

FIG. 6—Type of primitive Japanese hut surviving among modern peasantry. (Photograph by courtesy of the Freer Gallery of Art.)

FIG. 7—Famous shrine of the Sun Goddess at Ise, in which is preserved the primitive Japanese type of hut, allied to southern insular forms, very distinct from the Chinese style of architecture imported in historic times. (Photograph by courtesy of the Freer Gallery of Art.)

FIG. 8—View of Nara, one of the capitals of Japan in the eighth century, showing architecture of Chinese Buddhist origin.

Now the winters of the Japanese Pacific seaboard are mild, it is true, thanks to the Japan Current. But nowhere are they mild enough to admit of the winter ripening of crops, save in certain favored localities of Shikoku and Kyushu; and of Shikoku in this connection there is no question. Yet several modern writers, influenced by the similarity in sound, have insisted upon identifying Ye-ma-tʻai with the Japanese province of Yamato, far away to the eastward, in the heart of the mountainous peninsula forming the boundary of the Inland Sea in that direction. It is hard to believe, however, that when the careful and evidently well informed Chinese historians speak of a maritime region with an extremely mild winter climate, lying far to the south, they really mean an inland province with a decidedly cold winter, situated in the distant east.

Nevertheless there may exist a connection between Ye-ma-tʻai and Yamato after all. Both the Chinese historians and their own legends represent the primitive Japanese as located first of all in Kyushu, where in fact the word "Yamato" does actually occur, as a place name in both Higo and Chikugo provinces.[17] We know further that this name has been applied by the Japanese people to themselves in a very definite way; *Yamato damashii*, for example, means the spirit of the Japanese people, not that of the province of Yamato. Hence it seems possible at least that "Yamato" was the name applied to themselves, while still in Kyushu, by the people whom the Chinese usually referred to as the Wo and that when, as we shall see, they transferred their seat of government to central Japan they carried their name with them.

Culture Areas in the Korean Peninsula

The Korean peninsula during these times, just prior to and about the beginning of the Christian era, was divided into two quite distinct culture areas. In the north and extending over into what is now southern Manchuria were various tribes with cultures basically akin to those of eastern Siberia generally, though beginning to be modified by influences both from the neighboring Chinese states and from Central Asia.[18] Farther to the south the peninsula was the home of the peoples called by the early Chinese writers the "Three Han." While the precise boundaries of these are unknown, generally speaking the Ma-Han occupied the west and southwest of the peninsula, with the Shên-Han to the east of them, on the Sea of Japan, and the Pien-Han in the extreme south. These three Han peoples were clearly recognized by their Chinese contemporaries as quite distinct from their northern neighbors, while on the other hand there evidently existed between them and the primitive Japanese an extremely close kinship if not indeed an actual identity. The same was also true, apparently, of the people of Quelpart Island, where traces of southern contacts are unmistakable to this day.[19] This entire region, in fact, formed in prehistoric times a distinct culture area whose closest connections are to be sought in the Chinese coast lands as they were before they came under the influence of Chinese civilization. It was only shortly before the beginning of the Christian era that bands of refugees, fleeing from the wars then devastating China, founded various states in southern Korea in which they introduced that Late Bronze Age culture which then characterized their own country. Shên-Han—later the kingdom of Hsin-lo, or Silla—in spite of its comparative isolation with regard to China, maintained especially close relations with that country, and the consequent superiority in culture which it enjoyed as compared with its immediate neighbors is evident throughout its history.

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[17] Frank Brinkley and Baron Kikuchi: A History of the Japanese People from the Earliest Times to the End of the Meiji Era, New York and London, 1912, p. 84; W. G. Aston (transl.): *Nihongi*, Chronicles of Japan from the Earliest Times to A. D. 697, *Trans. and Proc. of the Japan Soc.*, Supplement 1, 2 vols., London, 1896, reference in Vol. 1, p. 226 and note 8.

[18] On the old Neolithic culture of eastern Asia, see R. and K. Torii: Études archéologiques et ethnologiques: Populations primitives de la Mongolie Orientale, *Journ. College of Sci., Tokyo Imp. Univ.*, Vol. 36, 1913–15, Art. 4; also review of same by H. Maspéro in *Bull. École Française d'Extrême Orient*, Vol. 14, 1914, pp 79–80.

Introduction of Bronze and Iron into Japan

There can be little doubt that it was from these newly founded states of southern Korea that metal was first introduced into Japan. The history of bronze in that country is peculiar. It cannot, in fact, be said that a true Bronze Age ever existed there at all.[20] The records of the Later Han Dynasty describe the people of Wo, early in the Christian era, as still in the Neolithic stage of culture. This statement regarding their ignorance of metal at that time is strikingly confirmed by the discovery in various parts of western Japan, in association with stone implements, of Chinese coins of the first century of our era.[21] The histories of the Wei and Chin dynasties, on the other hand, referring to the third and fourth centuries, mention iron as known to the Wo. It would appear, therefore, that the very brief and wholly exotic bronze culture which archeological research has disclosed to us in Japan must have fallen somewhere about the second century or so of our era.

Bronze remains in Japan are few and far between, and such as there are occur only in the western portion of the country. They are quite unknown anywhere to the east of the Lake Biwa area, that isthmian region of central Japan where the Ainu held back their Mongoloid foes through so many centuries. Aside from ceremonial objects, the known remains consist mainly of swords, daggers, and arrowheads—all closely resembling well known Chinese Bronze Age types. The discovery of molds indicates that some casting was done in Japan; but the raw material and a great proportion of the finished articles seem to have been imported, either from Korea or even direct from China, as is also suggested by the name, *Karakane*, which may mean either Korean or Chinese metal. Introduced only after its use in China had already been largely superseded by that of iron, it was but a short time before bronze was overtaken and displaced by the later metal in Japan also. And so effectively was it eclipsed, save of course for ornamental and ritual objects, that neither the *Kojiki* nor the *Nihongi*,[22] the two earliest Japanese historical works that have come down to us, betray the slightest recollection of a former Bronze Age; the use of copper arrowheads upon one occasion being mentioned solely as something unusual.

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[19] H. B. Hulbert: The Island of Quelpart, *Bull. Amer. Geogr. Soc.*, Vol. 37, 1905, pp. 396–408, *passim.*

For the probable Japanese affinities of the people of Quelpart, cf. E. H. Parker in *Chinese Recorder and Missionary Journ.*, 1885, p. 303; also W. G. Aston, *Nihongi*, Vol. 2, p. 323, note 5.

A seventh-century king of T'am-na, as the island was then called, bore a name, Yuritoro, which has a decidedly Japanese sound.

[20] The British Museum's "Guide to the Antiquities of the Bronze Age," 1904, is hardly exact in stating that the Japanese were already in the late Bronze Age when they entered the islands; they had long been in Japan when the knowledge of bronze was brought to them. It was a case of a cultural, not a racial, migration.

[21] Dr. K. Hamada, of the Kyoto Imperial University, in personal letters of July 10, 1917, and Dec. 20, 1920.

But, if the influence of bronze upon the cultural development of Japan was thus slight, with iron the case was far otherwise. Historical notices are wanting; but good grounds exist for thinking that iron reached Japan merely as one element of an entirely different material culture complex, partly Chinese and partly Central Asiatic in origin,[23] which had taken form somewhere in Korea and which was far higher than anything that the Japanese islands had yet known. That this cultural invasion was the result of actual conquest of any part of the country in a military sense cannot be categorically stated; but the presumption seems on the whole in favor of something of the kind.

OTHER EVIDENCES OF INVASION FROM KOREA

The evidence of language, for one thing, appears to point in this direction. Japanese belongs to an independent family, whose only other members are Korean and Loochooan, and such indications as there are point to central rather than to southern Asia as the region of its origin.[24] The most plausible conjecture—in the present state of our knowledge it can be nothing more—would seem to be that it reached Japan as the tongue of a relatively highly civilized body of invaders, not necessarily large, penetrating southward from the Korean peninsula and imposing their authority and their language upon the less civilized tribes, presumably of mixed Ainu and southern Mongoloid origin, whom they found in possession of the western portion of the islands. That such movements were constantly recurring within Korea itself, we know from the Chinese records. About 200 B. C., for example, when refugees from China conquered the state of Chao-hsien, in southern Manchuria, the king of the latter country escaped southward by sea with several thousand of his followers and secured a footing for a season in Ma-

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[22] The *Kojiki* dates from 712 A. D., the *Nihongi* from 720. Chamberlain's translation of the former and that of the latter by Aston have already been cited. There is also another of the later work, by Dr. Karl Florenz: Nihongi, "Zeitalter der Götter," Tokyo, 1901.

[23] Among the traces of Central Asiatic influence upon the Early Iron Age civilization of Japan are the reliance upon horse archers as the principal fighting arm; the use of the *nari-kabura* or "sounding arrow;" the sacredness attached to certain horses, usually piebald or albino; sword worship; divination by means of a deer's shoulder blade; and the custom of burying living retainers about the tumuli of kings and nobles.

Bashford Dean, in his "Catalogue of the Loan Collection of Japanese Armor," *Metropolitan Museum of Art, N. Y., Handbook No. 14*, 1903, p. 28, points out that the earliest metal armor of Japan, about 800 A. D., shows a relationship in many ways to that of central and eastern Russia.

[24] Legge ("Chinese Classics," Vol. 5, p. 74) makes the interesting suggestion that a polysyllabic language may have been spoken among the pre-Chinese natives of Shantung. As is well known, Chinese is monosyllabic and tonal.

Han in the southwest of the peninsula, only eventually to be beaten out again.[25] That a similar raid, or series of raids, during the latter half of the second century of our era or thereabouts, should have been the means of introducing an Early Iron Age culture among the Wo, seems both possible and plausible.

The most conspicuous feature of this period in Japan, next to the use of iron itself, was the practice of dolmen burial. A careful study of the available data, both historical and archeological, points to Korea again, and probably to the northern rather than the southern portion of the peninsula, as the source whence was introduced into Japan this custom of burying the illustrious dead in megalithic chambers covered by vast mounds of earth. Dolmens, in general somewhat smaller and simpler in type than those of Japan, occur in Korea in large numbers, particularly in the north. Farther down in the peninsula their place tends to be taken by still simpler stone cists; but these contain horse trappings, stone models of metal swords and arrowpoints, and wheel-made pottery, all closely resembling and in most cases absolutely identical with corresponding remains in dolmen interments in Japan.

It is matter of historical record, reinforced by archeological evidence, that this type of burial came to an end in Japan about the seventh or eighth century. Regarding the date of its beginning, however, opinions have been widely at variance, although generally speaking it has been placed far too early.

While it is true that bronze and even stone objects have been found in connection with Japanese dolmen interments, that these are mere funerary survivals is shown by the fact that the vast majority of implements are of iron from first to last. The occurrence of horse trappings in these interments is of great significance. The Chinese records are most explicit to the effect that the people of Japan and of southern Korea at the beginning of the Christian era and for at least a century or two after had neither horses nor cattle. Hence, inasmuch as stirrups, bits, and other objects of iron are recorded as occurring throughout the Dolmen Period, it follows that the latter itself can only date back to the epoch of the introduction of iron and the horse, somewhere apparently about the end of the second century.

The Introduction of Agriculture Proper

To what extent the primitive Japanese in days prior to the advent of metal depended upon planting for their subsistence we do not know; but the Chinese accounts afford evidence of what is otherwise intrinsically probable, that they possessed a hoe culture, carried on in all likelihood largely if not exclusively by the womenfolk. Under such a system, for several reasons, no very great growth of population could ever take place. It was only the introduction of true agriculture, which in southeastern Asia means the growing of irrigated rice, that made possible the vast increase in numbers and consequent economic and military strength essential to the development of a powerful national entity. This great advance in civilization was another element of that distinctive culture complex characterizing the Japanese Early Iron Age. That it too was derived from Korea is indicated, among other signs, by the entire absence in Japan of the water buffalo, the plow animal *par excellence* in the irrigated rice culture of China, and the use in its stead of a bullock of identical breed with that of the neighboring peninsula.

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[25] E. H. Parker: On Race Struggles in Corea, *Trans. Asiatic Soc. of Japan*, Vol. 18, 1890, pp. 157–228; reference on pp. 210 *et seq.*

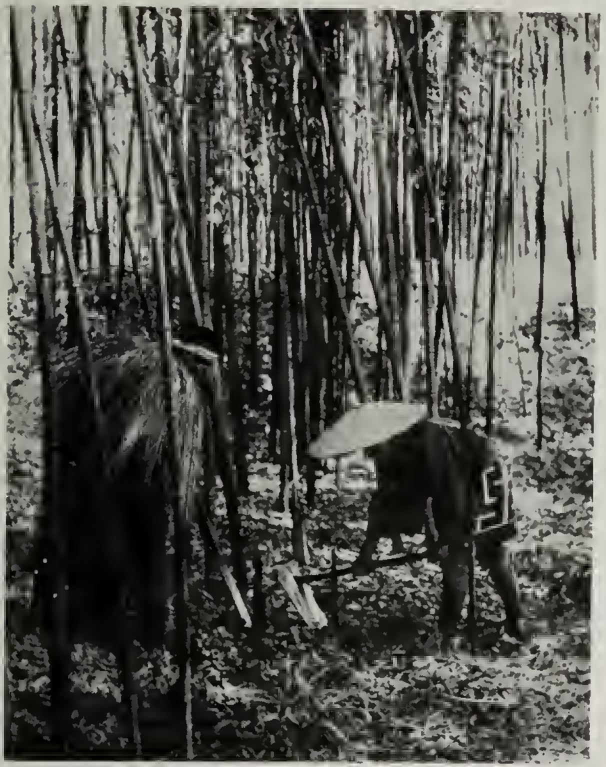

FIG. 9

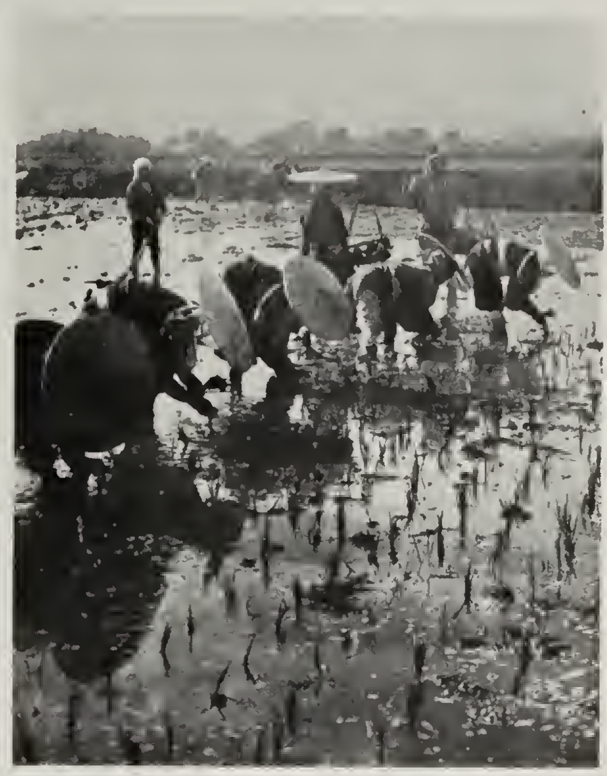

Fig. 10

FIG. 9—Japanese peasants digging edible bamboo shoots. The hat, raincoat, spade, hoe, and style of clothing are all traceable to the southern Chinese littoral.

FIG. 10—Japanese rice culture, introduced from south and central China, perhaps by way of Korea. Women in Japan still perform a large part of the field work, just as in primitive times. (Photograph by courtesy of the Freer Gallery of Art.)

Such a revolution in the economic life of a people as that implied by a change from a hoe to a plow culture has naturally its social aspects also. In hoe culture it is almost invariably the women who do the planting, while the men fish and hunt. No one exchanges the excitement and activity incident to the career of a hunter or a deep-sea fisherman for the monotonous drudgery that falls to the plowman's lot save under strong compulsion of some sort. In other words, the bringing about of such a change almost necessarily implies the relationship of master and serf. That such a system obtained in the Japan of the Early Iron Age, we have abundant evidence.[26] This fact affords additional presumption of conquest of some sort, whether from without or from within.

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[26] On this see, e. g., Hara, *op. cit.*, pp. 80 *et seq.*

Historical Evidence from Chinese Records

For such historical evidence as exists regarding this phase of Japan's cultural development we are still forced to rely almost wholly on the Chinese records. Writing seems to have been applied in Korea to the keeping of annals only toward the close of the fourth century of our era, and in Japan somewhat later still, so that what is told regarding earlier periods must rest solely upon oral tradition and legend.[27]

The histories of the Later Han and the Wei dynasties of China inform us that for a period of seventy or eighty years, ending about the close of the second century, the people of western Japan—from what cause, is not stated—were in great turmoil, the disturbances ending only with the rise of a powerful queen (almost certainly the "empress" Jingô Kôgô of Japanese legend) who by her command of magic extended her authority far and wide over the various tribes of the Wo.[28] She had, the accounts go on to say, no husband, but was assisted in governing by her brother—apparently an only partly understood instance of royal brother-and-sister marriage, a custom which we know formerly existed in Korea also.[29]

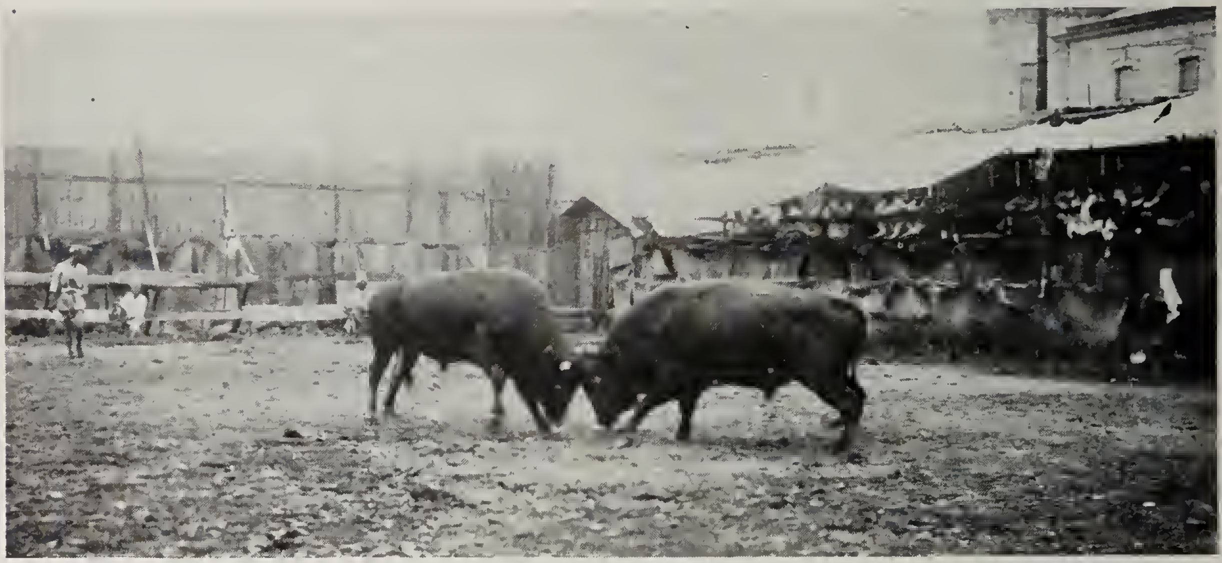

FIG. 11—Korean bullfight. These fights, originally of ritual significance, seem to have formed an element of the irrigated rice culture complex, in association with which they are found from Japan to Madagascar.

That a marked change of some kind, whether as the result of actual invasion or not, really did take place at this time is further shown by the fact that the Chinese records of the period sometimes refer to "Great Wo" by the alternative name of "the Queen Country," although declaring specifically that in earlier times it had been ruled over by kings. It seems to have been the case that these female rulers of the Wo derived their powers from a belief that they in some special sense—most likely through actual physical descent—represented the Sun Goddess, whose oracles and priestesses they were.

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[27] Maurice Courant, Stèle chinoise du royaume de Ko Kou Rye, *Journ. Asiatique*, Ser. 9, Vol. 11, 1898, pp. 210–238, states (pp. 223 *et seq.*) that writing became habitually used in western Korea in the last quarter of the fourth century. W. G. Aston, *Trans. Asiatic Soc. of Japan*, Vol. 16, 1888, p. 46, thinks Chinese writing (there is of course no question of any other) was diffused in the various Korean kingdoms in the last half of the same century. C. E. Maitre, *op. cit.*, p. 584, says writing was definitely introduced into Japan from Korea at the beginning of the fifth century.

[28] See Murdoch, *op. cit.*, Vol. 1, pp. 36 *et seq.*

[29] Hulbert, *op. cit.*, p. 81.

It was about this same period, apparently, that there arose on the main island, in what was later the province of Izumo, an independent kingdom which had especially close relations with the country of Hsin-lo, or Silla, facing it across the Sea of Japan.[30] It is perhaps in this Izumo region that is to be sought the land of Ko-nu, mentioned by contemporary Chinese writers as situated across the sea from Ye-ma-t'ai (in Kyushu, as we have seen), and more to the eastward. The people of Ko-nu, we are further told, although of the same race as the Wo, were generally on terms of hostility with the latter, and unlike them were ruled over by a king, who was in diplomatic correspondence with the Chinese representatives in Korea.

Thus it seems clear that beginning about the latter half of the second century western Japan was invaded from Korea by a decidedly high culture characterized by the use of iron, the manufacture of wheel-made pottery, the possession of domestic animals, the custom of fighting on horseback, the practice of true agriculture, and the burial of the illustrious dead in dolmens covered by huge mounds of earth. It is possible that the bow played a part in the extension of this culture; for the original Mongoloid settlers of western Japan, like their kinsmen of the Chinese littoral and so many of the modern peoples of Indo-China and Indonesia, appear to have been spearmen rather than archers.

Of the substitution of male rule for female rule among the Wo there is no historical record. But that it took place not long after the time of the great queen just mentioned, and that it was due to the growing influence of Chinese ideas, may be held as certain. The former divine queens seem to have survived merely as chief priestesses of the Sun cult, while the actual power was henceforth vested in the male heads of the ruling clan, the historical mikados, also of course descendants of the Sun Goddess and therefore god-kings in their own persons.

It was during this same period of her Early Iron Age that Japan received, through Korea but eventually from China, two fresh cultural acquisitions whose importance it would be difficult to exaggerate. These were the Buddhist faith and the art of writing. The story of the way in which these additional factors in the national life came to be introduced cannot be gone into here. But it will readily be seen how very great must have been their influence as unifying and civilizing agents among a congeries of tribes dwelling upon a relatively low culture plane and ruled over by a turbulent, disunited, and illiterate aristocracy which had as yet learned to pay but small respect to the authority of the central government.

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[30] On the contact between Hsin-lo and the Izumo region of Japan, see Aston, *Nihongi*, Vol. 1, p. 166 and note; W. E. Griffis: Corea, the Hermit Nation, New York, 1882; reference in Preface, p. v; Baelz, *op. cit.*, p. 525.

EXTENSION OF JAPANESE OCCUPATION OF THE MAIN ISLAND

The fact that bronze implements have been found only to the westward of the Lake Biwa region would suggest that the Mongoloid advance at the expense of the Ainu got no farther than that point until after the introduction of iron. It is possible, however, that even during the Neolithic period independent bands of the invaders may have cruised in canoes farther eastward, planting settlements along the coast but leaving the central mountain ranges in the hands of the aboriginal population. We know that it was by this method of coastwise advance in large fleets of war boats that the Japanese effected the conquest of much of the northern part of the main island in the full light of the historical period, during the seventh and eighth centuries; and it must have been by a similar process that they acquired a lodgment in the islands in the first place.[31] At all events there is some evidence, slight though it be and mainly of a legendary character, that the coastal plains as far east as Tokyo Bay were already occupied by settlements of peoples akin to but independent of the Yamato, when the latter established their supremacy there. The Yamato-dake story, for example, pure myth though it be in the main,[32] suggests this; for in it that hero appears as warring against peoples kindred to his own until he passes the mouth of Tokyo Bay (traveling by sea, be it noted); it is only beyond that point that he is represented as coming in contact with the Ainu.

It seems certain at any rate that the efforts of the Yamato to extend their authority over eastern Japan began very soon after their occupation of the Lake Biwa region. For the Japanese annals, just now beginning to have some slight historical value, mention a defeat inflicted at the end of the fourth century upon one of their war parties by the Ainu of the rugged peninsular region between Tokyo Bay and the Pacific Ocean. And eighty years or so later—in the year 478 A. D., to be exact—the Chinese records inform us that the emperor then reigning, Shun Ti, of the Early Sung Dynasty, received a letter[33] from the ruler of the Yamato, stating that his father had conquered toward the east fifty-five states of the Maojên, or "hairy men" (the Ainu, of course), and on the west sixty-six states of the I-jên, or "barbarians." Who these latter were, is uncertain; but they were perhaps most likely fragments of the pre-Yamato population of western Japan, of mixed Ainu and Mongoloid descent, which, dwelling in mountainous areas or outlying islands, had managed hitherto to escape conquest by the Yamato. Southern Kyushu in particular we know long remained independent and hostile. The almost entire absence of dolmens here indicates the slight control exercised by the Yamato over this region during their Early Iron Age, and this inference is most abundantly confirmed by their own records.

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[31] Regarding these boat expeditions, see Aston, *Nihongi*, Vol. 2, pp. 252 and 263; also, Hara, *op. cit.*, p. 110.

[32] For the Yamato-dake myth see Aston, *Nihongi*, Vol. 1, pp. 200 *et seq.*; B. H. Chamberlain, *Ko-ji-ki*, pp. 201 and 205 *et seq.*

[33] Thus showing that the Japanese were now beginning to conduct their diplomatic correspondence in writing, if indeed they had not already been doing so for a century or two; but the art remained for long a secret confined to certain hereditary guilds of Chinese or Korean extraction, whose members thus acquired vast influence with the rulers and great nobles of the Yamato whom they served as scribes.

Loss of Continental Territory

But, though the influence of the Mikados was being strengthened during this period in Japan proper, as much cannot be said with regard to their relations with the continent. During much of the Early Iron Age western Japan and particularly northern Kyushu seem to have been far less closely allied in feeling to the Yamato region than they were to southern Korea. At times this consciousness of kinship actually took the form of alliances between the peoples on the two sides of the Strait of Tsushima for waging war —"rebellion" in the official Japanese phraseology—against the divine Yamato rulers of central Japan. It was only by great efforts that the latter were able to maintain even the loosest control over their kinsfolk of the lower end of the peninsula.[34] Geography, in the shape of the hundred miles of sea between Japan and Korea, was working as inexorably against them as did the English Channel against the retention of Normandy by the English kings—in many ways a closely parallel case.

Finally, in the latter half of the seventh century the age-long friendship between the kingdom of Hsin-lo, the ancient Shên-Han, and China, then under the sway of the powerful T'ang Dynasty, culminated in a joint attack upon the Yamato by sea and land, which resulted in their total expulsion from the peninsula. The people of Quelpart, of Japanese or closely kindred stock, kept up for several centuries a quasi-independent existence as the kingdom of T'am-na but eventually gravitated toward Korea, geographical propinquity proving stronger than the ties of race and culture.

At the time, no doubt, this loss of the continental portion of their territory must have seemed a catastrophe of the direst sort. In the long run, however, it proved of incalculable benefit.[35] For, while receiving just as formerly the culture stimuli emanating from the continent, the Yamato no longer had to dissipate their energies in efforts to retain hold of regions on the mainland which were steadily growing farther apart from them in feeling and culture. Thus, able to give their undivided attention to their home problems, they set to work in earnest to obliterate the last remaining frontiers within the Japanese islands themselves.

Further Consolidation of the Insular Domain

The independent communities still surviving in the west, of which those mentioned as existing in southern Kyushu were the chief, were absorbed in short order. The last rising of the old independent stock of southern Kyushu took place at the end of the seventh century, barely a generation after the expulsion of the Yamato from their last foothold on the continent. But the separatist tendencies of the region, fostered by its geographical configura-

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[34] On the dominance of Japan in Korea during the early centuries of the Christian era, see Kanichi Asakawa: The Early Institutional Life of Japan, Tokyo, 1903, pp. 80 *et seq.*

[35] Hara, *op. cit.*, pp. 122 *et seq.*

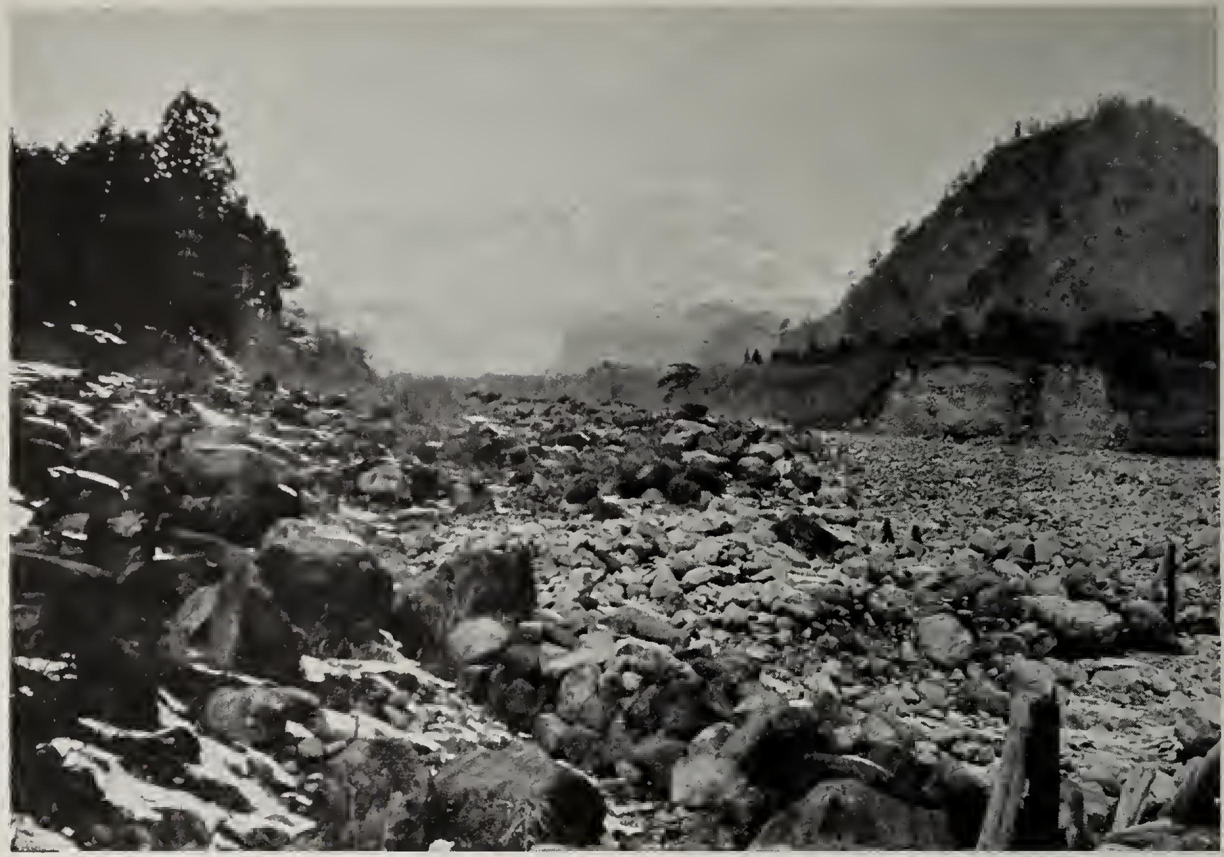

FIG. 12

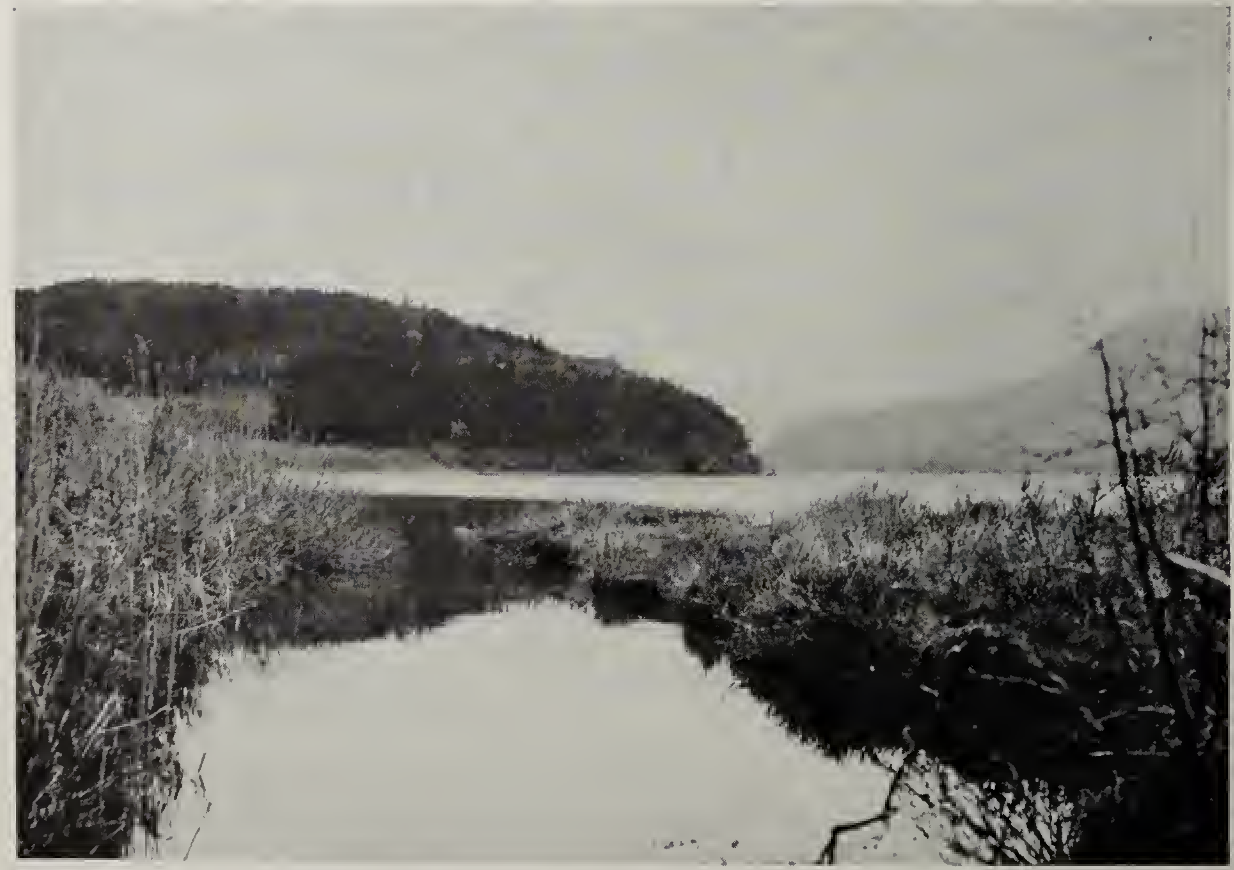

FIG. 13

FIG. 12—Typical Japanese torrent bed in winter. Owing to the almost total lack of navigable rivers, the original Japanese conquest was largely confined at first to seaboard plains accessible to their fleets of war boats.

FIG. 13—Lake Hakone, in central Japan, where the original Ainu long held back the Japanese invaders until outflanked by sea, as happened again and again, until the process of conquest had been completed.

FIG. 14

FIG. 15

FIG. 14—Winter scene in the Nikko range, part of the central backbone of Japan, in whose fastnesses Ainu types still sometimes occur in great purity.

FIG. 15—Looking north from the scarp of the ancient Japanese hill fort of Taga, toward the hills still held by the aboriginal Ainu in the eighth century.

tion, have been manifest throughout its history, the last instance being that of the famous "Satsuma rebellion" of 1877.

The subjugation of the still unconquered Ainu of the north and east presented a far more serious task. The mass of the people of western Japan, hardly touched by the new cultural influences from the continent, save in so far as these facilitated their exploitation by their rulers, had long since sunk to the status of abject predial serfdom and had lost such military virtues as they may once have possessed. The aristocracy, we know, were splendid warriors, gorgeously equipped and accustomed to fighting on horseback with longbow and sword. When called out *en masse* they no doubt proved a most effective if somewhat undisciplined militia. But aside from the personal guards of the rulers and great nobles, recruited largely from the Ainu and the pre-Yamato populations of southern Kyushu, there was no standing army and consequently no force ready at all times to take the field on short notice against the sudden incursions of the unconquered aborigines. These fierce fighters were by no means content merely to act on the defensive. Throughout their history as an independent people they evinced an entire willingness to meet their enemies quite halfway. Their usual method of waging war was to strike the settlements of the foe unawares and then be off again with their booty and captives, leaving behind them a trail marked in blood and fire, before troops could be brought up against them. The attitude of the bulk of the Japanese peasantry toward these savage raiders is vividly reflected in a very ancient song, attributed to the mythical hero Jimmu, which says that one Emishi (i. e. Ainu) is a match for a hundred men.

The Ainu Frontier

It was clearly for strategic reasons that the Yamato had moved their seat of government in the first place from Kyushu to the frontier region about Lake Biwa. For it was there that Ainu incursions were most to be dreaded and there, too, that they could be most easily repelled before they had penetrated far into the country. That such a radical change of base should have been made, in spite of the very great importance which we know the Yamato rulers attached to the maintenance of their hold on southern Korea, gives us a measure of the anxiety with which they regarded the "Ainu question." Only a motive of the utmost cogency could have induced them to remove so far from the position close to the Strait of Tsushima which they had hitherto occupied.

The settlement of the Ainu problem was at length effected; but it was only by dint of the hardest fighting, protracted through centuries. The possession of iron weapons and of a force of mounted archers accustomed to maneuver at a gallop over rough ground must have given the Yamato a great advantage over the Ainu in the open field. But as the latter were slowly pushed back northeastward they absorbed more and more of the civilization of their enemies with a consequent increase in their own powers of resistance, while the Yamato armies, on the other hand, advancing both by land and by sea, met with ever greater difficulty in getting up their supplies from the cultivated districts far in their rear. Moreover, it was not enough merely to occupy the lowlands near the coast with blockhouses and military colonies. The central mountain ranges had also to be invaded and their inhabitants dispossessed or subdued, if there was to be any security for the always lengthening lines of communication. In view of the overwhelming difficulties attending the task, it is no wonder that it was so long of accomplishment; while the dogged stubbornness with which the centuries-long battle was waged on both sides says a vast deal for the fighting qualities of Ainu and Yamato alike.

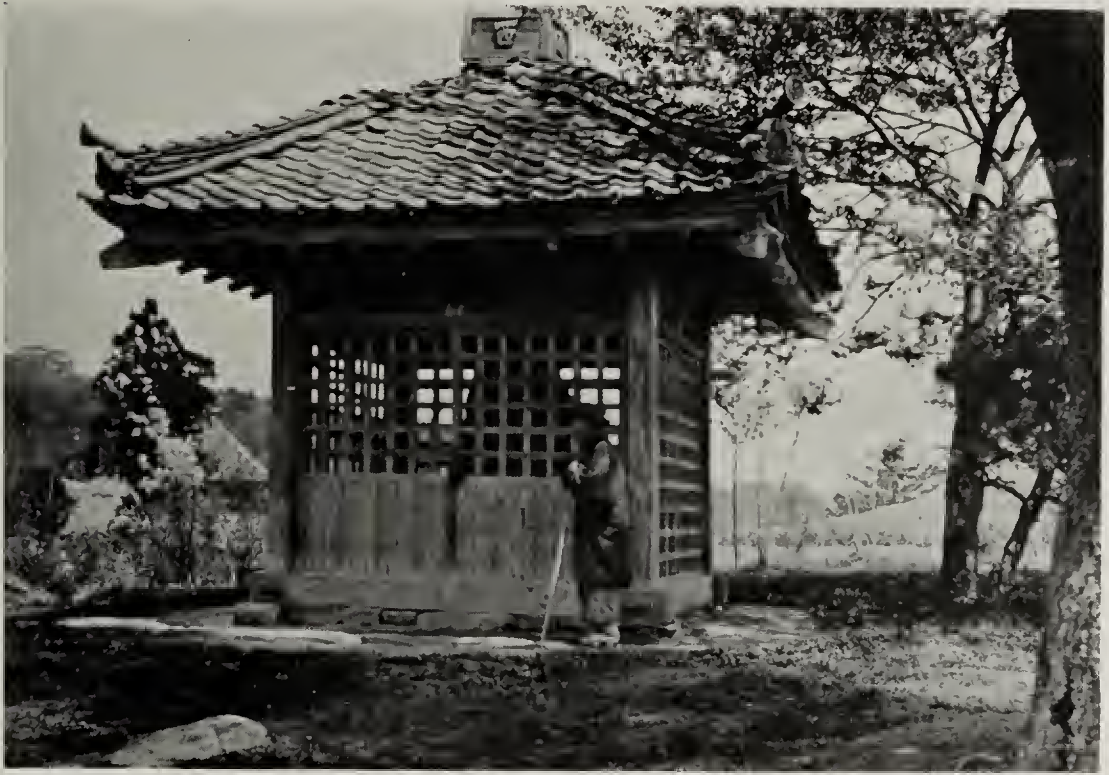

FIG. 16—Inscribed stone of the eighth century at the Taga fort, near the ancient Ainu Japanese-frontier, a few miles north of the modern city of Sendai.

For some reason progress was much more rapid on the west than on the east coast, so that about the close of the seventh century the Yamato had after a fashion occupied the territory along the Sea of Japan nearly up to the 39th parallel. On the Pacific side the Ainu were then holding out along a line roughly corresponding to latitude 37° N. The next few campaigns pushed the frontier back, on the west, as far as a spot a trifle south of latitude 40° N., where the Akita fort was built. From this point the boundary extended in a general southeasterly direction across the central mountain ranges to the Pacific, reaching the coast about in latitude 38° 40′ N., some fifty miles or so north of the Taga fort, whose overgrown earthworks still stand, not far from the present city of Sendai.[36]

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[36] On the successive old Yamato-Ainu frontiers, see Hara, *op. cit.*, pp. 67 *et seq.*, 86 *et seq.*, 104, 119, 147 *et seq.*; N. G. Munro, Primitive Culture in Japan, *Trans. Asiatic Soc. of Japan*, Vol. 34, Part II, 1906, pp. 1–198; reference on p. 166; *idem*, Prehistoric Japan, p. 597.

At this point, in the latter half of the eighth century, the still unconquered Ainu made a desperate effort to regain their lost ground. They took the Taga fort, massacred its commander and garrison, and pushed far down the eastern coastal plain toward that Tokyo Bay region from which their ancestors had been driven something like three hundred years before.

But the Yamato government, albeit with difficulty, kept large forces in the field year after year, while the aborigines, barbarians as they were, aided in their own subjugation by indulging in suicidal wars among themselves. It was fortunate for them that the Yamato, before the loss of their continental possessions left them free to attend to their internal problems, had adopted the peaceful and humane creed of Buddhism with its aversion from bloodshed. For, in obedience to the behests of their faith, they carried on no mere war of extermination but made a genuine effort to civilize and assimilate the conquered natives and to place them on the same footing with the other subjects of the Mikado. At first prisoners of war were distributed in the western part of the islands in small bodies and were given rations until they should learn to become self-supporting; while later on the policy was adopted of organizing them into villages on the same basis as the rural population elsewhere. Thousands of them, first-class fighting men as they were, accepted enrollment in the Japanese armies for service against their still unsubdued kinsmen. Offices and gifts were bestowed on surrendered chieftains, while missionaries, in some cases themselves converted Ainu who had taken holy orders, made every effort to win the aborigines to the Buddhist faith.

Final Conquest of the Ainu

Finally by the close of the tenth century the subjugation of the Ainu of the main island could be regarded as accomplished. But it was long before they were completely assimilated. They rose again and again, even as late as 1332, while a few villages of them were still to be found about the shores of Aomori Bay so recently as the eighteenth century.

That portion of the race living in Yezo, Sakhalin, and the Kuriles retained its independence for some time longer. The last serious effort of the Yezo Ainu to expel the Japanese occurred in the latter part of the seventeenth century, when with their primitive weapons they made a brave but hopeless fight against their foes clad in iron armor and equipped with matchlock guns and keen steel swords.

As a distinct people the Ainu have almost wholly disappeared, with the exception of the few thousands still living in the island of Yezo. Nevertheless they form a very large element in the racial composition of the Japanese nation to this day.[37] As usual in cases where crossing has occurred between

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[37] On the large Ainu part in the modern Japanese racial complex, see Kanichi Asakawa: The Origin of the Feudal Land Tenure in Japan, *Amer. Hist. Rev.*, Vol. 20, 1914–15, pp. 1–23; reference on p. 17; Matsumoto, *op. cit.*, pp. 73, 75 *et seq.;* David MacRitchie: The Aïnos, *Internationales Archiv für Ethnographie*, Vol. 4, Supplement, 1892, *passim;* Romyn Hitchcock, *op. cit.*, p. 450.

N. G. Munro (Prehistoric Japan, p. 634) says the religion of the Yamato was much more deeply influenced by the Ainu than is generally supposed.

Mongoloid and other races, the external physical characteristics of the former have tended to be dominant, although apparently the same does not hold to quite the same extent regarding skeletal traits. Traces of Ainu mixture are visible throughout the country, from the Loochoos and Satsuma in the far south to Yezo on the north, while in isolated regions like the mountain fastnesses of Kozuke, Shinano, and Echigo provinces in the center of the main island, there still occur surprising numbers of pure Ainu types. Particularly strong was this strain among the former Samurai, or knightly class, in large part descended from the Ainu incorporated in the Japanese armies of the eighth and ninth centuries.[38] To this inheritance it was that the haughty two-sworded man of later times owed his less Mongoloid features, ruddier complexion, and heavier beard, to say nothing of his splendid fighting qualities.

It would be difficult to exaggerate the influence which the Ainu have exerted over the historical development of the Japanese Empire. For to the long centuries of warfare which their subjugation entailed were due the rise of that hereditary warrior class and that system of military government, without which Japan would almost certainly have vegetated into a second Korea—in other words, a feeble imitation of China, without either the will or the force to think and act for herself. It is pleasant to be able to state, from personal observation, that the Japanese authorities are doing all that they can to elevate and educate the remnant of the Ainu and assist them to a point where they can take their proper place as civilized men and women in the world of the twentieth century.

Conclusion

The physical and cultural traits which we regard as peculiarly Japanese may, then, be traced to three separate and distinct geographical areas.[39] Basically, both in race and in the fundamentals of their culture, the Japanese are most closely akin to the ancient inhabitants of the Asiatic coast lands during the Neolithic period. Superimposed upon this foundation and affecting mainly the ruling classes, was that higher type of civilization which began to reach Japan about the beginning of our era and which was accompanied by a certain infusion of fresh blood, largely from Korea but also to a not inconsiderable extent direct from China. Finally, to the long contact with the ancient aborigines were due the addition of a most valuable element in the racial complex and the acquisition of that fighting spirit, with its traditions of unflinching loyalty and self-sacrifice, that has been so largely responsible for the rise of Japan as a modern Power.

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[38] Asakawa, Origin of Feudal Land Tenure, p. 17; Matsumoto, *op. cit.*, pp. 75 *et seq.*

[39] H. J. Fleure (Geographical Factors, Helps for Students Series, No. 44, London, 1921) makes the interesting suggestion that it may be the imperfect accord of widely separated inheritances in the same individual that has given the Japanese the sensitiveness to climatic differences which has hitherto stood in the way of their succeeding as colonists in Formosa or Sakhalin.

THE OCEANOGRAPHY OF THE PERUVIAN LITTORAL WITH REFERENCE TO THE ABUNDANCE AND DISTRIBUTION OF MARINE LIFE

By Robert Cushman Murphy
American Museum of Natural History

The Humboldt Current, which flows northward along the Pacific coast of South America, is directly responsible for certain striking phenomena of oceanic distribution. It is responsible also for the existence in littoral waters of a vast abundance of marine organisms, upon which are dependent in turn unsurpassed fisheries resources, as well as the remarkable modern Peruvian guano industry concerning which authoritative information has recently become available.[1] Hydrographic and biological investigations in the Humboldt Current strike, therefore, at the roots of important problems of ecology, of the geographic distribution of life, and of the application of science to economic affairs. A discussion of these subjects in the light of information acquired during a recent expedition of the Brooklyn Museum[2] is the object of the present paper.

Characteristics of Oceanic Circulation Along the Coasts of America

For a comprehension of conditions in the Humboldt Current the circulation of both northern and southern hemispheres must be considered together; and, moreover, the system of the western coast of the Americas must be contrasted with the diametrically opposite expression of the same causes which obtains on the Atlantic side of the continents.

Owing to the progressive increase in the eastward linear velocity of the earth's surface from either pole toward the equator, masses (as of air or water) moving in the direction of the equator necessarily fail to maintain an easterly component equal to that of the parallels of latitude at which they are successively arriving. In other words, they "fall behind," or turn toward the right in the northern hemisphere and toward the left in the southern.[3]

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[1] R. E. Coker: The Fisheries and the Guano Industry of Peru, *Bull. Bur. of Fisheries*, Vol. 28, 1908, Part I, pp. 333–365.

Idem: An Illustration of Practical Results from the Protection of Natural Resources, *Science*, No. 1370, Vol. 53, 1921, pp. 295–298.

J. A. de Lavalle: El guano y la agricultura nacional, Lima, [1914], p. 1–111.

R. C. Murphy: The Guano Industry of Modern Peru, *Brooklyn Museum Quart.*, Vol. 7, 1920, pp. 244–269.

[2] R. C. Murphy: The Seacoast and Islands of Peru, *Brooklyn Museum Quart.*, Vol. 7, No. 2, 1920, to Vol. 9, No. 4, 1922.

[3] For the mathematical explanation of this phenomenon see G. F. McEwen: Peculiarities of the California Climate Explained on the Basis of General Principles of Atmospheric and Oceanic Circulation, *Monthly Weather Rev.*, Vol. 42, 1914, pp. 14–23.

The converse is true of currents moving away from the equator or in the direction of the poles. These elementary facts explain why both the meteorological and the oceanic circulatory systems are clockwise in the northern hemisphere and counterclockwise in the southern hemisphere.

The primary geophysical results of the circumstances just cited are that in middle latitudes the movement of ocean currents along the east coast of both Americas is in the general direction of the poles, whereas on the west coast the flow is equatorward. It follows that in the Atlantic littoral region tropical or subtropical hydrographic conditions obtain through many degrees of latitude (roughly 60°), while in the Pacific littoral they are contracted to a breadth of barely 30° of latitude owing to the intrusion toward the equator of cool currents from both the north and the south. As a matter of fact, the only characteristically tropical or subtropical Pacific waters in contact with the coast of America lie in the narrow zone between the Gulf of Guayaquil (latitude 3° S.) and the Gulf of California.

The Humboldt Current

The Humboldt Current is a northerly branch of the Pacific Antarctic drift, and in both extent and influence it is perhaps the most remarkable of oceanic streams. It owes its origin chiefly to the prevailing westerly winds of high southern latitudes and to the meteorological whirl of the eastern South Pacific. It is particularly noteworthy for its sustained low temperature. The apparently anomalous circumstances were first noted by Alexander von Humboldt in 1802, when the great cosmographer observed surface temperatures of 59.9° F. at Callao in the early part of November—readings which were extraordinarily different from others taken in the outlying tropical Pacific. It has since been determined that the mean annual temperatures of waters close to the shore line of central Peru are, in fact, from 18° to 20° F. lower than the theoretical values for the latitudes.

The current laves the western coast of South America from a point somewhere south of 40° S., to the vicinity of the westernmost projection of the continent at Point Pariña (4° 40′ S.), whence the main branch sets west-northwestward, flows on both sides of the Galapagos Islands, and is lost beyond longitude 100° W. in the south equatorial drift.

It would seem that the current is most apparent, as a factor to be taken account of by navigators, after it departs from the South American coast. Between Cape Blanco and the Galapagos Islands, Fitzroy, commander of the *Beagle* "was set fifty miles to the west-northwest" in the twenty-four hours preceding his making the archipelago from the southeast.[4] In the same region Colnett "fell in frequently with streams of current, at least a mile in breadth, and of which there was no apparent termination. They frequently changed the ship's course, against her helm, half the compass, although running at the rate of three miles and an half an hour. . . . The froth and boil of these streams appear at a very small distance like heavy breakers."[5] Further evidence of the activity of oceanic circulation about the Galapagos is afforded by one of Fitzroy's observations, made in October, 1835, when surface temperatures on opposite sides of Albemarle Island were found to be respectively 80° F. and less than 60° F.[6]

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[4] Robert Fitzroy: Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle, 3 vols., London, 1839; reference in Vol. 2, p. 505, footnote.

In addition to the main or westerly branch of the Humboldt Current, a minor effluent, which turns northeastward after passing Point Pariña and flows along the Ecuadorian coast into the Bay of Panama, is apparent at certain seasons.

Thermal Characteristics of the Humboldt Current

Significant thermal features of the surface waters in the littoral portion of the current, with which this paper is concerned, are (1) relatively low temperatures in close proximity to the land, with rising temperatures off shore along lines perpendicular to the trend of the coast; and (2) extraordinary uniformity of temperatures throughout the greater part of the length of the current, a uniformity which is little affected by either latitude or season of the year. Both of these facts would of themselves strongly suggest that the low temperatures close to shore are due to upwelling from the "polar creep" rather than to the actual northward transportation of subantarctic surface waters. The conditions are totally unlike those of warm currents, such as the Gulf Stream and the Brazil Current, which undoubtedly carry identical masses of water for great distances. It must be borne in mind that oceanic streams of the latter type are in their entirety surface flows, which usually if not always rest upon layers of colder and denser waters.

The researches of McEwen[7] have made it clear that the low surface temperatures in the inshore areas of the California Current are due exclusively to upwelling of bottom water caused by the broad belt of northwesterly winds along the Pacific coast of North America. Such winds, acting upon a principle previously referred to, cause the moving surface water to swing gradually toward the right, or off shore, whereupon it is replaced by water from deeper layers. In like manner south of the equator an accelerated left-hand trend and continuous vertical circulation are caused in the Humboldt Current by steady southerly winds, parallel to the coast, which tend to force the surface water off shore at an angle of 45° from their path. For the same reason and also because the submarine slope of the continent shoulders off to seaward the warmer and lighter surface waters of a deep, impinging stream, the water closest to shore is the coldest. The steeper the coastal slope, the greater the reduction of surface temperature, for the narrower and more concentrated is the belt of upwelling bottom water.

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[5] James Colnett: A Voyage to the South Atlantic and Round Cape Horn into the Pacific Ocean, London, 1798, pp. 45–46.

[6] Fitzroy, *op. cit.*, p. 505.

[7] G. F. McEwen: The Distribution of Ocean Temperatures along the West Coast of North America Deduced from Ekman's Theory of the Upwelling of Cold Water from the Adjacent Ocean Depths, *Internatl. Rev. der gesamt. Hydrobiol. und Hydrogr.*, Vol. 5, 1912, pp. 243–286.

During five months' field work in 1919 and 1920, the writer recorded upwards of 300 surface temperature observations in the Humboldt Current at points between Independencia Bay (14° 18′ S.) and the northern waters of Peru (4° S.).[8] Although many of the readings proved slightly higher than ranges obtained during the earlier and more extensive work of Coker,[9] the general conclusions of the latter were confirmed. These are (1) that only very slight latitudinal changes in the surface temperature of the inshore coastal water occur along the whole length of the Peruvian coast between Mollendo and Paita (1000 nautical miles) and (2) that the small observable variations are due chiefly to local influences and only in much slighter degree to seasonal conditions.

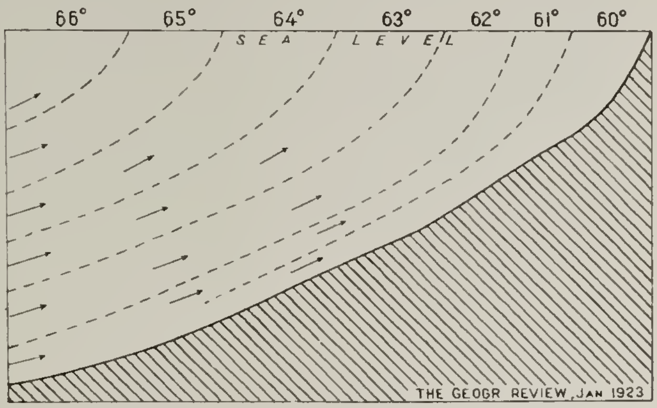

Fig. 1—Diagram illustrating the probable relation between the upwelling of bottom water and decreasing shoreward temperatures in the Humboldt Current (width of cross section approximately 10 sea miles). For a discussion of parallel conditions on the west coast of Africa see Alfred Franz: Beiträge zur Ozeanographie und Klimatologie der Deutsch-Sudwestafrikanischen Küste nach Beobachtungen von S. M. S. *Möwe, Archiv der Deutschen Seewarte,* Vol. 38, No. 1, 1920.

Earlier investigators[10] than Coker have established the fact that the uniform temperature conditions of the Peruvian coast are carried southward in the Humboldt Current at least as far as Valparaiso, Chile. It is in accord with the abyssal topography that the current, as characterized by upwelling waters, should begin near Valparaiso, for just south of that port the great bank on which Juan Fernandez lies extends to the westward more than twenty degrees of longitude.

TEMPERATURE FLUCTUATIONS IN THE CURRENT

Average temperatures within five miles of shore along the greater part of the coast of Peru range between about 58° F. (14.44° C.) and 64° F. (17.78° C.) throughout the year. At times, however, irregular variations are apparent locally, or even extensively, such changes being commonly attributed to a shifting of the course of the Humboldt Current, that is to influences which cause the stream to swing temporarily off shore. This assumed phenomenon, mentioned by Coker, is universally accepted as a fact in Peru. The alleged aberrations are recognized by the native fishermen through the effect upon the catch of anchovies, bonitos, or other fishes;[11] and by the inhabitants of coastal towns through the effect upon climate. Exceptionally warm weather at Lima—such as obtained, for example, during part of the winter season (June-Sept.) of 1919—is credited in popular opinion to the retreat of the current from the coast.

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[8] The instruments used were among equipment generously supplied by the American Geographical Society and comprised United States naval thermometers (Fahrenheit) and specially constructed maximum and minimum thermometers of Six's type, all manufactured and calibrated by the Henry J. Green Co.

[9] R. E. Coker: Ocean Temperatures Off the Coast of Peru, *Geogr. Rev.*, Vol. 5, 1918, pp. 127–135.

[10] Otto Krümmel: Handbuch der Ozeanographie, 2nd edit., 2 vols., Stuttgart, 1907 and 1911; reference in Vol. 2, p. 715 (quoting observations by Capt. Paul Hoffmann).

J. Y. Buchanan: On the Similarities in the Physical Geography of the Great Oceans, *Proc. Royal Geogr. Soc.*, Vol. 8, 1886, pp. 753–770; reference on p. 765.

It is the writer's belief that such phenomena are to be interpreted in another way. Many observers, from the days of Fitzroy to the present, have noted that an alteration or reversal or "set to southward" in oceanic circulation along the Peruvian coast is likely to occur from time to time and that such changes often coincide with or follow northerly winds. We have abundant evidence that the friction between atmosphere and hydrosphere produces a quick response. The normal conditions in the Peruvian littoral are due to prevailing southerly winds which, except for the well known day and night swing, vary remarkably little from one year's end to another. When, however, this uniform meteorological control temporarily gives way to northerly winds there is a tendency to drive the warmer offshore surface waters towards the land at an angle of 45°, and an immediate effect is seen in the partial or complete cessation of upwelling. Moreover, the fact that the calculated eastward pressure of the Humboldt Current is literally blocked by the half-submerged Andean wall, makes the explanation just given more satisfactory than the pure assumption that the current sometimes shifts its course to westward, an assumption which has perhaps been made through false analogy with the very different hydrographic system of the Atlantic Gulf Stream.

The Countercurrent

Paracas Peninsula and San Gallan Island (13° 50′ S.), which project into the Pacific at the "bend" of the Peruvian coast, appear to mark the boundary between two littoral regions of somewhat different oceanographic character. To the southward of this point conditions in the coastal water which depend in the main upon constant upwelling attain their maximum of uniformity;[12] to the northward the generally stable equilibrium is at times disturbed not only by such relatively insignificant fluctuations as have already been referred to but also by influences of a more profound nature. Especially to the northward of Salaverry (8° 13′ S.), seasonal influxes of warmer waters from equatorial regions sometimes raise the temperatures considerably above normal over wide areas. The advancing tropical waters form an indubitable countercurrent, which is known to the inhabitants of the coast as *El Niño* (The Child) because it often becomes evident about Christmas time.

This countercurrent, which Coker has described,[13] made its appearance at the time of the writer's field work among the northern Peruvian islands, in January, 1920. On the second of this month, the average of 11 surface temperatures taken during a period of six hours off Pacasmayo (7° 24′ S.) was 60.4° F. (15.78° C.). Two weeks later (Jan. 15 and 16), however, 17 temperatures obtained during 28 hours in the same area averaged approximately 69° F. (20.56° C.). The explanation is that the warm waters of *El Niño* had overflowed the northern end of the Humboldt Current in the interim.

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[11] Coker, Ocean Temperatures, p. 132.

[12] Coker, *ibid.*, p. 133, found absolutely no seasonal variation in surface temperatures on an exposed shore at Mollendo.

[13] *Ibid.*

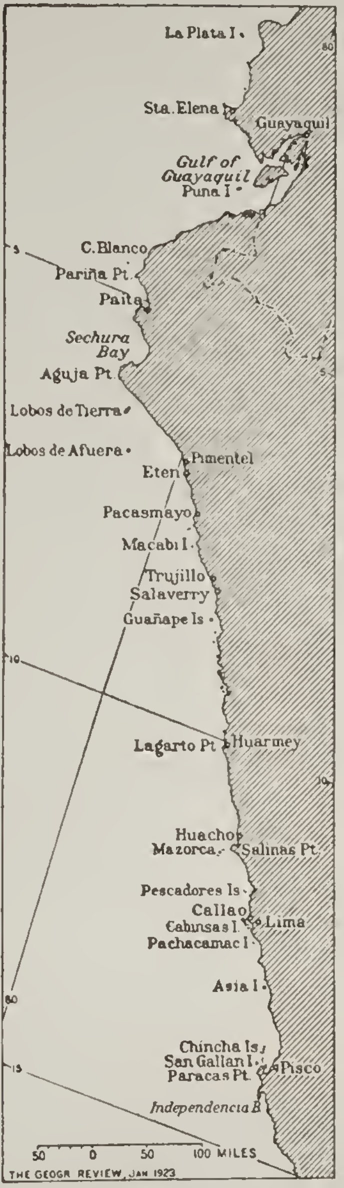

FIG. 2—Sketch map of the Peruvian coast to show localities mentioned in the text.

The countercurrent has long been an object of interest to navigators and other observers in Peru. It has been discussed in many issues of the *Boletín* of the Geographical Society of Lima, beginning with the first volume in 1892, and its imperfectly known characteristics are recorded in the Peruvian *derroteros*, or pilot books, of Melo and Stiglich. Stiglich[14] and other Peruvian writers infer that the countercurrent proceeds from the river Guayas (emptying into the Gulf of Guayaquil) in freshet season, but the volume of water in this source would be insufficient to account for the observed effects. The current should be attributed rather to the periodic even though variable changes in barometric pressure which occur when the belt of maximum insolation is well south of the equator.

Aside from the previously noted increase of ocean temperatures off Pacasmayo, the writer's field notebook contains numerous inferential references to the southward extension of *El Niño* in January, 1920. Among these are the following:

1. The captain of the Chilean steamship *Huasco* testified that on January 10, while passing northward between the Lobos Islands (6° 27′—6° 56′ S.), the course of his vessel was perceptibly affected by a strong northwestward set of the Humboldt Current. On the following morning, however, off Sechura (5° 35′ S.) he encountered an adverse current, flowing southward past Paita and noticeable thereafter along the entire length of the coast of Ecuador.

2. On January 24, near the Guañape Islands (8° 35′ S.), when the temperature of the surface of the ocean was 67.5° F. (19.72° C.), or from 6 to 7 degrees higher than it had been on January 1, many *mantas*, or large rays,[15] were seen leaping from the water into the air. Ordinarily these somersaulting fishes are to be observed only in the extreme northern waters of Peru, north of Point Pariña. Their jumping is a common phenomenon in the tropical ocean off Ecuador. Near La Plata Island (1° 16′ S.), for instance, the writer noted them in great abundance on September 5, 1919, and again in early February, 1920. The commander of the *Huasco* (Captain Herbert Gregory) maintained that the migration of the jumping rays down the Peruvian coast as far southward as Salaverry and the Guañapes is always coincident with other manifestations of *El Niño*.

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[14] Germán Stiglich: Derrotero de la costa del Perú, Lima, 1918, p. 8.

[15] It has not been possible, in default of specimens, to identify this large and conspicuous species.

3. On January 24 large numbers of dead boobies, of a species (*Sula variegata*) which lays its eggs on the ledges of the Peruvian islands, were observed along scummy drift lines extending for miles to the *southward* of Macabi and Guañape Islands. Ordinarily the lines of foam produced by the rocks and islets of the coast stretch away to the northward, and the dead birds, chiefly nestlings which have fallen from the cliffs, are carried rapidly in the same direction by the flow of the Humboldt Current.

The problems of the countercurrent have recently been attacked by Lavalle[16] in relation to a peculiar pandemic disease of the Peruvian guano birds, which he has diagnosed as "aspergilosis." This malady appears at intervals of years, and its visible effects have been mentioned from early times in maritime books and in the logs of ships.[17] During the outbreaks countless numbers of the littoral sea birds die upon the breeding grounds or the water, their bodies subsequently washing ashore by thousands and strewing the beaches for miles.

Lavalle attributes the disease of the birds, together with the meteorological and hydrographic changes which ordinarily precede its appearance, to the southward advance of *El Niño*. After calling attention to the fact that the temperature of the tropical current is normally not less than 5° C. higher than that of the most northerly waters of the Humboldt Current near Cape Blanco, he remarks that fish and nearly all forms of plankton are killed by abrupt temperature changes of this magnitude. Correlating his hypothesis with phenomena observed in 1917 or recounted in the literature of the subject, Lavalle evolves a rational exposition of the relation between the advance of the countercurrent, accompanied by changes in ocean temperature, atmospheric humidity, etc., and its secondary effects such as the mortality of fish and birds and the irruption of the renowned "Callao Painter." The latter phenomenon, which is known also as "*aguaje*" and "*agua enferma*," is in general confined to the stretch of water between Paita (5° 05′ S.) and Pisco (13° 43′ S.), and more especially to that between Pacasmayo (7° 24′ S.) and Callao (12° 04′ S.). Its immediate cause, according to Lavalle, is the accumulation of enormous quantities of plankton, killed by the rise of ocean temperatures, in protected localities where, owing to the coastal contour, centripetal eddies exist. The bay of Callao is one of several such places. Here the penetration of the sun's rays into the shallow water hastens decomposition of the mass of organisms, which are so thick as to discolor the ocean. Active production of hydrogen sulphide and other gases results, and for a while the affected areas become as toxic to life as the depths of the Black Sea.[18]

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[16] J. A. de Lavalle: Informe preliminar sobre la causa de la mortalidad de las aves ocurida en el mes de marzo del presente año, *Memoria de la Compañía Administradora del Guano*, Vol. 8, 1917, pp. 61–84.

[17] Rear Admiral C. F. Goodrich, U. S. N., has informed the writer that on August 10 and 11, 1899, the U. S. S. *Newark*, under his command, passed for three hundred miles through areas of dead pelicans and other sea birds in the northern waters of Peru. The position of the vessel at noon of August 11 was 5° 07′ S. (off Paita), 45 miles from the coast.

[18] W. E. Allen (Problems of Floral Dominance in the Open Sea, *Ecology*, Vol. 2, 1921, pp. 26–31) has recently directed attention to the extreme sensitiveness of diatoms and other marine organisms to changes in salinity, light, density, temperature, and hydrogen-ion concentration and to the possibilities of sudden, excessive, and finally fatal development of one or more species of organisms to the exclusion of other related or competing forms.

It is easy to understand the effect of the countercurrent upon the piscivorous sea birds of the Peruvian coast. Lavalle[19] states that in March, 1917, before *El Niño* had become perceptible about the Guañape Islands but after it had been reported farther to the northward, great numbers of pelicans arrived at Guañape, having abandoned their feeding grounds in the neighborhood of the Lobos Islands at the approach of the warmer water. Shortly afterwards the total sea bird population of Cabinsas (12° 09′ S.) fled in like manner from their threatened territory and settled at Pachacamac and Asia Islands (respectively 12° 19′ S. and 12° 48′ S.). The ultimate fate of all birds which do not migrate in this way to the "safe" waters of the southern half of the Peruvian coast is a loss of food supply and a lowering of vitality which renders the victims an easy prey to infectious pulmonary disease caused by a fungus, *Aspergillus fumigatus*, or by related organisms. If the countercurrent continues its advance as far south as the Pisco Bay region, hundreds of thousands of the priceless guano birds may perish before the rhythms of nature restore favorable life conditions throughout the field of the Humboldt Current.

EVIDENCE AS TO THE PREVAILING UNIFORMITY OF HYDROGRAPHIC CONDITIONS IN THE CURRENT

It should not be forgotten that cataclysmic disturbances, such as have just been described, obtain at only rare intervals and are the exception rather than the rule. Extraordinary uniformity is, after all, the outstanding hydrographic feature of the Peruvian littoral. The very fact that relatively slight fluctuations toward the border line of a distinct oceanic region so profoundly affect the whole life association of the Humboldt Current is in itself evidence that this life must have become thus inflexibly adapted through the long duration of substantially invariable conditions.

Essential uniformity in the Humboldt Current is indicated by temperature data alone, but confirmation drawn from a study of the diatomaceous flora may serve to emphasize the prevailing physical stability.

Townet collections obtained by the writer, together with samples of bird guano of various ages and from several different islands in the Humboldt Current, were submitted to Dr. Albert Mann, of the Carnegie Institution, who has reported by letter upon their diatom content. Some of the guano samples were excavated in deep, so-called "fossil" beds on Lobos de Afuera and Lobos de Tierra, where it must have been deposited so long ago that its age can be reckoned only by centuries. Both the ancient and the recent guano, as well as the plankton collected in townets along some 700 miles of the coast, proved to be rich in diatoms. The point of particular interest is that all of this material, whether collected in October or in February, whether at Independencia Bay (14° 15′ S.) or near the Lobos Islands (7° S.), whether captured in the haul of a silk net or extracted from guano deposited by four or more species of sea birds an hour, a month, a year, or five hundred years before—contained the same characteristic species of diatoms. Certain prevalent forms, such as *Skeletonema costatum*, *Grammatophora marina*, and various species of the genus *Coccinodiscus*, appear in nearly all of the diverse samples which were analyzed. Dr. Mann writes:

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[19] Informe preliminar, p. 22.

> There is considerable similarity between the different guanos in the species of diatoms they contain. In fact no sample stands out as radically unlike the rest, as would be the case were the plankton flora of the ocean a totally dissimilar one at any of the periods of time represented by any one of the samples. This in itself is interesting; because it is no infrequent thing for the diatom flora of a given locality to be strikingly dissimilar on two successive years. Thus the diatoms of Woods Hole, Massachusetts, were very different in 1920 from those found in 1919.[20]

Temperature Ranges in the Humboldt Current

The lowest surface temperature recorded by the writer at stations between Independencia Bay and the Gulf of Guayaquil was 58° F. (14.44° C.), a figure obtained at various times and places. In order to indicate the constancy of upwelling along a great extent of coast, it will be useful to cite the entire list of readings of 60° F. (15.56° C.) or lower.

The lowest temperature readings were obtained close to mainland or insular shore lines and in situations open to free circulation such as the *boquerones* or straits south of Callao and Pisco, the exposed southern entrance of Independencia Bay, etc. In passing from the sheltered waters of Pisco Bay through the constricted *boqueron* which separates Paracas Peninsula from San Gallan Island, surface temperatures in November, 1919, were found to decrease ten degrees Fahrenheit, or from 68° F. (20° C.) to 58° F. (14.44° C.).

Distance from the land, or in any direction away from an exposed islet in the Humboldt Current, is usually concomitant with increase of surface temperature. When traveling parallel with the mainland coast, a mile or more off shore, an observer finds that water temperatures are likely to be lower abreast of a projecting headland than they are off a bight. In short, the lines of equal temperature follow the turnings of the coast line, and a boat bound along shore repeatedly cuts the isothermic curves. Such observations indicate that the upwelling waters are being continually deflected to seaward as they strike exposed bottom slopes of the continental shelf.

The relation between temperature and distance from the Peruvian coast is well shown in Tables II–IV.

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[20] More recently Albert Mann (The Dependence of the Fishes on the Diatoms, *Ecology*, Vol. 2, 1921, pp. 79–83) has published notes which, by contrast, serve to stress still further the perhaps unique uniformity of the diatom flora in waters along the coast of Peru. Referring to conditions which hold for most parts of the world, he writes that there are clearly marked zonal and local diatom floras and that great variation in the constitution and abundance of this element of the plankton occurs from year to year. "Thus the diatom combination of Beaufort, N. C., is easily distinguished from that of Woods Hole, Mass., while that found along the shores of Florida is even more dissimilar." It may be added that the Peruvian coast line, where such variations are not found, is not greatly shorter than the Atlantic coast of the United States.

TABLE I—TEMPERATURE READINGS OF 60°F. (15.56°C.) OR BELOW

DAY	HOUR	PLACE	TEMPERATURE	
			°F.	°C.
Oct. 8	9 A. M.	Huacho Bay	59.5	(15.28)
	10 A. M.	Huacho Bay	59.6	(15.33)
	1 P. M.	N. end of Salinas Promontory	59.0	(15.00)
	1:30 P. M.	N. E. of Mazorca Island	59.8	(15.44)
16	12 M.	Chincha Is. (Central I.)	58.0	(14.44)
	6 P. M.	Chincha Is. (Central I.)	59.1	(15.05)
17	8 A. M.	Chincha Is. (Central I.)	60.0	(15.56)
	1 P. M.	Chincha Is. (South I.)	59.0	(15.00)
18	8 A. M.	Chincha Is. (Central I.)	60.0	(15.56)
19	10:20 A. M.	N. W. of Paracas Point	59.2	(15.11)
	10:55 A. M.	½ mile N. of Paracas Point	60.0	(15.56)
Nov. 10	7:45 A. M.	Chincha Is. (Central I.)	60.0	(15.56)
	8:07 A. M.	Chincha Is. (Central I.)	59.4	(15.22)
	9:10 A. M.	Point Lastre, Paracas Bay	59.6	(15.33)
15	11:40 A. M.	N. W. of Paracas Point	58.0	(14.44)
	12:10 P. M.	E. of San Gallan Island	58.0	(14.44)
	12:35 P. M.	Boqueron of San Gallan I.	58.5	(14.72)
15–19		Independencia Bay (minimum tube)	58.8	(14.89)
26	10:25 A. M.	N. bight of San Gallan I.	60.0	(15.56)
Dec. 12	11:50 A. M.	Callao Bay	59.8	(15.44)
15	8:15 A. M.	Pescadores Island	59.5	(15.28)
	8:30 A. M.	Gallinazo Islet, Pescadores group	60.0	(15.56)
Jan. 2	1:10 P. M.	1 mile off Pacasmayo	59.8	(15.44)
	1:18 P. M.	¼ mile off Pacasmayo pier	59.5	(15.28)
2, 3		Pacasmayo anchorage (minimum tube)	58.2	(14.56)

TABLE II—DECREASING TEMPERATURES OBTAINED WHILE BOUND TOWARD SHORE AT HUARMEY (10° 06′ S.), DEC. 30, 1919

10:30 A. M.	10 miles S. W. of Lagarto Head	67.0° F.	(19.44° C.)
11:30 A. M.	8 miles W. by S. of Lagarto Head	65.0	(18.33)
12:30 P. M.	5 miles off Lagarto Head	63.8	(17.67)
1:25 P. M.	Rounding Lagarto Head (entrance to Huarmey)	61.6	(16.44)

TABLE III—DECREASING TEMPERATURES OBTAINED WHILE APPROACHING LOBOS DE TIERRA FROM THE SEAWARD SIDE, JAN. 6, 1920

12:05 P. M.	8 miles from Lobos de Tierra	69.0° F.	(20.56° C.)
1 P. M.	4 miles from Lobos de Tierra	68.1	(20.05)
1:50 P. M.	2 miles from Lobos de Tierra	67.7	(19.83)
2:30 P. M.	1 mile from Lobos de Tierra	66.0	(18.89)
3:20 P. M.	At anchor, Caleta de Cherra	65.5	(18.61)

It would appear that Lobos de Tierra, the largest of the Peruvian islands, simulates the continent in producing upwelling from lower layers of water.

On January 15 and 16, 1920, after the mingling waters of *El Niño* had raised the general level of surface temperatures off northern Peru, a series of 17 readings, taken along an oblique line across the normal path of the Humboldt Current, still showed a gradual decrease from 70.2° F. (21.22° C.) one-half mile east of Lobos de Tierra to 66.5° F. (19.17° C.) near the end of the pier at Eten (6° 56′ S.).

TABLE IV—INCREASING TEMPERATURES OBTAINED WHILE BOUND FROM PACASMAYO TO LOBOS DE AFUERA ISLAND, JAN. 3 AND 4, 1920

6 P. M.	Pacasmayo (28 hour minimum)	58.2° F.	(14.56° C.)
9 P. M.	11 ? miles off shore	61.5	(16.39)
6:30 A. M.	21 ? miles E. S. E. of Lobos de Afuera	66.2	(19.00)
7:10 A. M.	18 ? miles E. S. E. of Lobos de Afuera	66.5	(19.17)
7:35 A. M.	16 ? miles E. S. E. of Lobos de Afuera	66.7	(19.28)
8:45 A. M.	12 miles E. by S. of Lobos de Afuera	67.0	(19.44)
9:30 A. M.	8 miles E. by S. of Lobos de Afuera	67.2	(19.56)
10:20 A. M.	4 miles E. by S. of Lobos de Afuera	68.0	(20.00)
10:35 A. M.	3 miles E. by S. of Lobos de Afuera	68.0	(20.00)
10:50 A. M.	1 mile from Lobos de Afuera	69.0	(20.56)
11 A. M.	Anchorage ¼ mile from shore	68.7	(20.39)

Again, on February 3–7, 1920, temperatures of 66.2° F. (19.00° C.) close to the beach at Salaverry increased steadily off shore and to the northward, reaching 75.2° F. (24.00° C.) near Point Pariña (4° 40′ S.) on February 4, 79° F. (26.11° C.) off the Gulf of Guayaquil, and 80° F. (26.66° C.) off Point Santa Elena (2° 12′ S.), Ecuador. The last two figures are close to the yearly mean temperature not only of the Ecuadorian littoral but also of the offshore waters of the southern tropical Pacific, outside the zone of upwelling, at least as far to the southward as the latitude of central Peru (e. g. 14° S.). Captain Paul Hoffmann[21] found, for example, that surface temperatures of 64.9° F. (18.3° C.) at Callao rose progressively to 81.0° F. (27.00° C.) at 135 nautical miles from shore. Data from the *Albatross* records of 1904, quoted in substance by Coker,[22] further support the conclusions which must be drawn.

By bringing together available thermometric readings accompanied by exact locations the writer has computed that 1.5° F. represents an approximation of the average rise in temperature per nautical mile from the coast line of central and northern Peru. The rate would not, of course, apply during an active advance of the countercurrent. Moreover, because of the paucity of the observations and the fact that the ratio between temperature and distance is unlikely to be constant across the full width of the Humboldt Current, the figure can be considered as only suggestive.

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[21] Paul Hoffmann: Zur Mechanik der Meeresströmungen an der Oberfläche der Oceane, Berlin, 1884, p. 76.

[22] Ocean Temperatures, p. 130.

As regards normal maximum temperatures in the Humboldt Current, the data are rather difficult to interpret because most of the high readings can be attributed to special circumstances. Great variation occurs, as Coker has pointed out, in enclosed bays, where eddies form and where the same masses of shallow water lie until they can be warmed by the sun. Doubtless the best conception of average high temperatures will be derived from considering a series of records from exposed situations, such as the Chincha Islands or the Guañape and Lobos Islands before the surrounding waters had been warmed by the countercurrent of January, 1920.

Ranges of surface temperatures at fixed points, with data on diurnal and nocturnal variation, are given in Table V, which comprises readings obtained with both the Six's and the naval thermometers.

TABLE V—TEMPERATURE RECORDS IN THE HUMBOLDT CURRENT, OCTOBER, 1919—FEBRUARY, 1920

DATE	PLACE	RECORD	LOWEST		HIGHEST	
			°F.	°C.	°F.	°C.
1919						
Oct. 11	Central Chincha Is.	24 hours	63.2	(17.3)	65.0	(18.3)
Oct. 13	Central Chincha Is.	48 hours	60.8	(16.0)	61.2	(16.2)
Oct. 14	Central Chincha Is.	22 hours	59.0	(15.0)	63.7	(17.6)
Oct. 16	Central Chincha Is.	2 readings, 12 M., 6 P. M.	58.0	(14.4)	59.1	(15.0)
Oct. 17	Central Chincha Is.	3 readings				
Oct. 18	Central Chincha Is.	4 readings, 8 A. M., 3 P. M.	60.0	(15.5)	63.1	(17.3)
Oct. 21	Central Chincha Is.	4 readings, 8 A. M., 3 P. M.	63.7	(17.6)	64.9	(18.3)
Oct. 24	Central Chincha Is.	2 readings, 8 A. M., 6 P. M.	63.0	(17.2)	63.8	(17.7)
Oct. 25	Central and North Is. (4 stations)	4 readings, 8 A. M., 10 A. M.	61.4	(16.3)	63.9	(17.7)
Oct. 26	Central Chincha Is.	3 readings, 8 A. M., 1 P. M.	62.0	(16.7)	63.3	(17.4)
Nov. 22	Central Chincha Is.	4 readings, 6:30 P. M., 2:30 P. M.	64.5	(18.0)	65.3	(18.5)
Nov. 23	Central and North Is. (6 stations)	6 readings, 9:30 A. M., 8:30 A. M.	62.8	(17.1)	63.8	(17.7)
Nov. 26	North Chincha Is.	48 hours	60.8	(16.0)	62.3	(16.8)
Nov. 15–19	Independencia Bay	84 hours	58.8	(14.9)	63.6	(17.5)
Dec. 28	Palominos Rocks (off Callao)	3 readings, 2:30 P. M., 7:15 P. M.	62.0	(16.7)	63.0	(17.2)
1920						
Jan. 1	South Guañape Is.	24 hours	60.8	(16.0)	63.3	(17.4)
Jan. 3	Pacasmayo (anchorage)	28 hours	58.2	(14.5)	60.8	(16.0)
Feb. 1	Bay of Callao	2 readings, 11 A. M., 6:30 P. M.	63.6	(17.5)	64.0	(17.8)

Records made with the maximum-minimum thermometer at Independencia Bay and elsewhere show that the average of maxima for the day period (7 A. M.—7 P. M.) is about 2° F. higher than the average maxima for the night period. For additional data on these very slight changes, which are a further indication of upwelling, Coker's paper should be consulted.

Readings of from 68° F. (20.00° C.) to 69° F. (20.56° C.) were made in parts of the Bay of Pisco during October and November; but these were in every case explained by the discharge of freshet waters from the Pisco River, which turned toward the left or south from its mouth and formed a counter-clockwise eddy distinguishable from the bay water by color as well as by temperature. Similar phenomena, with increases of temperature amounting to 6° or 7° F., were noted on February 3, off the mouth of the River Chicama, north of Salaverry. With these exceptions, no temperature higher than 66° F. (18.89° C.) was obtained within twelve miles of the Peruvian mainland until after the first signs of *El Niño* in January. It need hardly be added, however, that high temperatures were recorded everywhere *off shore* during the whole period of field work.

The Breadth of the Humboldt Current as Compared with That of the California Current

Stiglich[23] states that the mean breadth of the Humboldt Current along the coast of Peru is about 150 miles, a figure which, from a navigator's point of view, is doubtless roughly correct. We have records of very few temperature observations along lines extending across stream to the warm outlying ocean, but the *Albatross* tables[24] and the readings of Captain Hoffmann show that the belt of cool water is extraordinarily narrow when compared with conditions in the corresponding region of the North Pacific. The fact is confirmed, furthermore, by studies of the biota of the Humboldt Current, for the characteristic algae, as well as the invertebrates, fishes, and higher forms of life, are all confined to waters near the coast.[25]

Recent investigations in the California Current by the hydrographic staff of the Scripps Institution for Biological Research reveal an order which is at striking variance with that of the Peruvian littoral. The California Current, at least off the southern Pacific coast of the United States, is a remarkably broad stream, the effects of which can be detected a thousand or more miles from shore. Again, the zone of maximum upwelling, and consequently of lowest temperatures and greatest profusion of marine life, lies far off the coast, in sharp contrast with the respective conditions off the west coast of South America. Michael[26] sums up the data for the California Current as follows:

> Between July, 1917, and June, 1918, and within a strip of water extending approximately one hundred twenty-five nautical miles seaward from Point Fermin, volume of phytoplankton, collected in vertical hauls from 200 meters to the surface, when corrected for the effect

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[23] *Op. cit.*, p. 8.

[24] *Bur. of Fisheries Doc. No. 604*, 1906, pp. 54–58.

[25] Estimates of the breadth of the Humboldt Current as deduced from meteorological observations conform with those based upon other data. Cf. Mark Jefferson: The Rainfall of Chile, *Amer. Geogr. Soc. Research Ser.*, No. 7, 1921, p. 8.

[26] E. L. Michael: Effect of Upwelling Water upon the Organic Fertility of the Sea in the Region of Southern California, *Bernice P. Bishop Museum Special Publ. No. 7, Part II*, 1921, pp. 555–595; reference on p. 589.

of season, increased, on the average, from a minimum nearest shore to a maximum about seventy miles off and then decreased with further increase in distance.

The surface temperature, simultaneously observed at the places phytoplankton was collected, decreased on the average, when corrected for the effect of season, from a maximum nearest shore to a minimum about seventy miles off and then increased with further increase in distance.

The explanation of these contrasts, which are at first puzzling, is doubtless to be found in the very different relative trends of the Pacific coast lines of North and South America and in the dissimilar topography of the respective continental shelves. A glance at the map, especially at a globe, will show the great divergence of the coasts of the Californias from the course of the clockwise, or right-hand, southward-flowing current. The coast of Peru, on the contrary, trending sharply to westward from near the Chilean border, extends far into the ideal course of the Humboldt Current and forces the latter to become an actively impinging stream until it has passed the end of the continental buffer at Point Pariña. A bathymetric chart throws further light on factors which produce dissimilar zones of upwelling in the two hemispheres. The South American coastal shelf, between Valparaiso and northernmost Peru, is narrower, more steeply terraced, and far less irregular along its outer border than the west coast of North America. Since upwelling is most pronounced where the transition from deep to shallow water is most abrupt, the reason for the low ocean temperature very close to the Peruvian coast is obvious.

THE VELOCITY OF THE HUMBOLDT CURRENT

Existing data on the rate of flow of the Humboldt Current have been derived mostly from the reports of seafarers whose reckonings have been thrown out by this disconcerting and largely unmeasurable factor. The pilot books rather vaguely assign a velocity of "15 miles per day," a "general set of ½ to 1 knot," "a speed of one mile per hour throughout the year," etc. The effect of the flow is, of course, universally recognized as favorable or adverse in navigation, depending upon the direction of a voyage.[27]

The writer made numerous attempts to measure the rate of flow with a Gurley current meter. Many of the trials were fruitless because the revolutions of the instrument, suspended from one to fifty feet beneath the surface of the sea, were affected by unavoidable jerky movements of an anchored trawler or schooner. The following three readings, each based upon from 6 to 26 counts, were made under generally favorable circumstances. The rates, especially the second and the third, are believed to be not far from approximations of the truth. They are offered here for whatever they may be worth.

1. ½ mile west of South Chincha Island, Oct. 17, 1919. Average of 6 measurements of one minute each. Current of 1.4 statute miles per hour, setting toward the coast (considerably to east of north). The sea was choppy, probably causing an acceleration of the

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[27] Coker, Ocean Temperatures, p. 132.

beats of the instrument, so that this reading is considered less dependable than those which follow.

2. Middle of southern entrance of Independencia Bay (Serrate Channel), Nov. 16, 1919. Average of 17 measurements of one minute each. Current of .64 statute miles per hour, setting 45° west of north. The ocean was calm and the station fully exposed to the movement of the current. The beats of the electric indicator were regular, and all indications are that the computation is reliable.

3. 250 yards east of the south point of South Guañape Island, Jan. 6, 1920. Average of 26 measurements of one minute's duration. Current of .7 statute miles per hour, setting 30° west of north. Ocean calm; open sea toward the source of the flow. This is probably the least inaccurate of all the records.

The average of the three velocities is .91 statute miles per hour. The writer has no data as to a possible tidal influence in any of the measurements, but it is not likely to have been significant.

Captains of *caleteras*, or coastwise steamers which call at all the Peruvian ports, informed the writer that the current is a factor to be seriously considered in steamship navigation only in two parts of their route: the first along the southerly coast of Peru, northward from Mollendo, and the second on the reaches between Eten and Point Aguja, in the north. In the latter region, according to the testimony of one captain, the stream frequently maintains a northwesterly rate of one knot for days together. These reports are in harmony with theory, for we might expect the maximum rate of flow where the coast trends to westward and thus deflects the centrifugal pressure.

Ecology of the Humboldt Current

The geophysical characteristics of the Peruvian littoral offer favorable life conditions for a great profusion of marine organisms. In the first place, the low salinity, due to upwelling of water more or less polar in origin, and more particularly the low temperature facilitate absorption of atmospheric gases and the retention of those produced by the metabolism of oceanic plants and animals. Again, low salinity makes possible the solution or suspension of increased proportions of silica, which, together with nitrogen compounds and phosphoric acid, is among the minimal nutritional elements upon which all life in the sea is ultimately dependent.

The reduction of buoyancy due to lowered salinity is more than made up by the increased viscosity resulting from low temperature, viscosity being the most important property of sea water for inhibiting the descent of minute forms of life to unfavorable levels. Other things being equal, water at a freezing temperature offers twice as much resistance against sinking as water at 77° F.

Finally, the stable temperature of the littoral water, except during the rare invasions of *El Niño*, results in life conditions which are far more uniform than along most of the temperate Atlantic coasts where marked periodicity is the rule.

The organic source of all food in the sea, for abyssal creatures as well as those of the surface strata and of the atmosphere above, is the microscopic plant life, comprising mostly the brown algae (Phaeophyceae), which, obtaining their nitrogen directly from nitrates in the circulation, build up tissue that becomes the food of copepods and other crustaceans, certain fishes, etc., which, in their turn, are devoured by higher animals. In the presence of sunlight the microscopic plants, moreover, assimilate the carbon of carbonic acid and restore the oxygen to solution, thus bettering the conditions for animal life. Under optimum circumstances, the algae may number as many as 40,000 individuals per liter of ocean water.[28] They exist principally in a layer within fifty fathoms of the surface, though they may sometimes penetrate three or four times as far, and their dead remains are uninterruptedly settling into the lightless depths. But vertical circulation, which is continually bringing masses of deeper water to the surface along the inner border of the Humboldt Current, is thereby steadily restoring nutritive substances, in the form of decomposition products such as ammonia, to the upper layer of the ocean. Here, if not directly available for the algae, they may be utilized by nitrifying bacteria and worked over into material which enables the profuse development of plant life to go on. The quantity of phytoplankton varies directly with the amount of upwelled water, and for this reason the marine areas in which ascending currents occur are favored with the most prolific efflorescence of both microörganisms and higher creatures. On the other hand, surface life is always least abundant in anticyclonic or dead-water regions, like the Atlantic Sargasso Sea, where the surface layers continually sink.

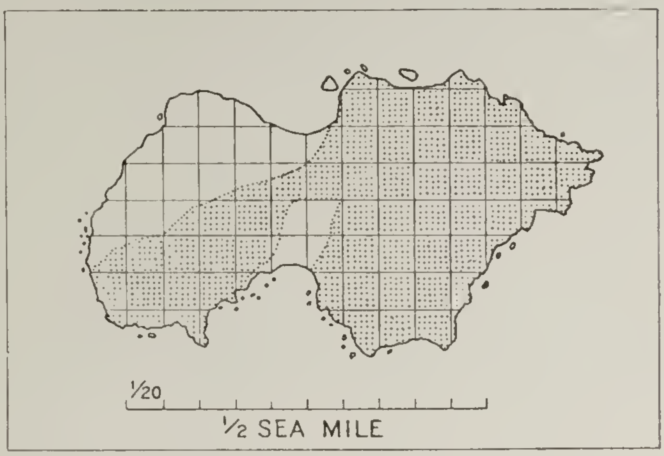

FIG. 3—Sketch map of Central Chincha Island, Pisco Bay, showing in shading the area occupied by *guanayes* or white-breasted cormorants (*Phalacrocorax bougainvillei*) on January 1, 1913. Copied from a manuscript report by H. O. Forbes. A conservative estimate would place the total bird population, young and adult, at 5,600,000. Not less than a thousand tons of fish per day would be required to sustain such a colony.

It has been suggested that another possible effect of the upwelling of cold bottom waters results from the fact that even moderately low temperatures inhibit the activity of denitrifying bacteria.[29] It has been shown, however, that in the presence of sufficient free oxygen these bacteria never exhibit their power of denitrification, even though they may multiply indefinitely.[30] In view of the favorable conditions for the production and retention of oxygen in the cool waters off the west coast of South America, it appears that the suppression of the denitrifying bacteria is here of no great consequence as a partial explanation of the abundant life.

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[28] W. E. Allen: Observations on Surface Distribution of Marine Diatoms between San Diego and Seattle, *Ecology*, Vol. 3, 1922, pp. 140–145.

[29] Cf. H. F. Osborn: The Origin and Evolution of Life, New York, 1917, p. 91

[30] John Murray and Johan Hjort: The Depths of the Ocean, 1912, pp. 369, 370.

ABUNDANCE OF LIFE IN THE HUMBOLDT CURRENT

Thirty-five years ago Buchanan wrote, "No waters in the ocean so teem with life as those on the west coast of South America.[31] More recent investigations have borne out this statement. Space cannot be spared for lengthy quotations relating to the lower animals, but Bigelow's remarks[32] are doubly interesting in that they refer both to the abundance of life in the current and to the contrasting conditions in the warm water areas beyond. He writes:

> I cannot pass over without mention the extraordinary richness of the Humboldt Current in pelagic life of all kinds; a richness which has already been noted in the account of the general oceanographic features of the Eastern Tropical Pacific by its [the expedition's] leader, who speaks of "such masses of Salpae, of Cytaeis, or Cymbulia, or swarms of other pelagic animals as to make a thick soup" . . ., and of enormous quantities of copepods, schizopods, Doliolum, and Medusae. Nor can I omit to recall the discovery, immediately to the west and southwest of the Current, of an area as barren in all forms of life, bottom as well as pelagic, as the latter is rich. Thus "As soon as we ran outside of this [the Humboldt Current] the character of the surface fauna changed; it became less and less abundant as we made our way to Easter Island, the western half of the line from Callao becoming gradually barren." On entering the current again from the barren area the reverse change was equally striking.

An impressive picture of the unparalleled profusion of organisms, particularly of fishes and birds, has been given in the publications of Coker, Forbes, Lavalle, Chapman, Murphy, and other writers.[33]

Coker, for example, records the following:

> In contrast to the barrenness of the coast [of Peru] there is a peculiar wealth of certain forms in the open ocean. The great red seas, formed sometimes, at least, of myriads of microscopic dinoflagellates, are of common occurrence. . . . Sometimes, too, great areas of the surface of the sea are reddened by the vast numbers of small crustacea (*Munida*),

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[31] Buchanan, *op. cit.*, p. 766.

[32] H. B. Bigelow: Reports of the Scientific Results of the Expedition to the Eastern Tropical Pacific, in Charge of Alexander Agassiz, . . . XVI, The Medusae, *Memoirs Museum of Comp. Zoöl. at Harvard College*, Vol. 37, 1909, p. 222.

[33] The more important references follow:

R. E. Coker: Numerous articles in the *Bol. Minist. de Fomento*, Vols. 5 to 7, 1907–1909, Lima.

Idem: Regarding the Future of the Guano Industry and the Guano-Producing Birds of Peru, *Science*, No. 706, Vol. 28, 1908, pp. 58–64.

Idem: The Fisheries and the Guano Industry of Peru, *Bull. Bur. of Fisheries*, Vol. 28, 1908, Part I, pp. 333–365.

Idem: Habits and Economic Relations of the Guano Birds of Peru, *Proc. U. S. Natl. Museum*, Vol. 56, 1920, pp. 449–511.

Idem: Peru's Wealth-Producing Birds, *Natl. Geogr. Mag.*, Vol. 37, 1920, pp. 537–566.

Idem: An Illustration of Practical Results from the Protection of Natural Resources, *Science*, No. 1370, Vol. 53, 1921, pp. 295–298.

H. O. Forbes: The Peruvian Guano Islands, *The Ibis* (10), Vol. 1, 1913, pp. 709–712 (under "Notes and Discussion").

Idem: Puntos principales del informe presentado al supremo gobierno por el ornitólogo Dr. H. O. Forbes, *Memoria de la Compañia Administradora del Guano*, Vol. 5, 1914, pp. 57–105, Lima.

Idem: Notes on Molina's Pelican, *The Ibis* (10), Vol. 2, 1914, pp. 403–420.

J. A. de Lavalle: Informe preliminar sobre la causa de la mortalidad de las aves ocurida en el mes de marzo del presente año, *Memoria de la Compañia Administradora del Guano*, Vol. 8, 1917, pp. 61–84, Lima.

Idem: Estudio sobre los factores que influyen sobre la distribucion de los nidos de las aves productoras de guano, *ibid.*, 1918, Vol. 9, pp. 207–213.

F. M. Chapman: Notes from a Traveler in the Tropics, III, *Bird-Lore*, Vol. 21, 1919, pp. 87–91.

R. C. Murphy: The Seacoast and Islands of Peru, *Brooklyn Museum Quart.*, Vol. 7, No. 2, 1920 to Vol. 9. No. 4, 1922; especially Part 3, pp. 244–269; Part 4, pp. 17, 18; Part 5, p. 48; Part 8, pp. 64–68.

> which then play a part of great importance as food for the fishes and for the guano-producing birds. More striking still are the immense schools of small fishes, the "anchobetas" (*Engraulis ringens* Jenyns), which are followed by numbers of bonitos and other fishes and by sea lions, while at the same time they are preyed upon by the flocks of cormorants, pelicans, gannets, and other abundant sea birds. It is these birds, however, that offer the most impressive sight. The long files of pelicans, the low-moving black clouds of cormorants, or the rainstorms of plunging gannets probably cannot be equaled in any other part of the world. These birds feed chiefly, almost exclusively, upon the anchobetas. The anchobeta, then, is not only . . . the food of the larger fishes, but, as the food of the birds, it is the source from which is derived each year probably a score of thousands of tons of high-grade bird guano. . . . No more forcible testimony to its abundance could be offered than the estimate, made roughly, but with not wide inaccuracy, that a single flock of cormorants observed at the Chincha Islands would consume each year a weight of these fish equal to one-fourth of the entire catch of the fisheries of the United States.[34]

THE DISTRIBUTION OF LIFE AS AFFECTED BY THE HUMBOLDT CURRENT

Next to the extraordinary abundance of marine organisms in low southern latitudes, the predominant zoölogical characteristic of the Peruvian littoral is to be found in the unequaled northward distribution of antarctic or subantarctic types.

Examples to illustrate this fact could be drawn from many subdivisions of the animal kingdom, but the writer will confine his choice chiefly to the higher vertebrates with which, as a systematist, he is familiar. In the category of Peruvian species which are of distinctly austral or subpolar affinities are the following:

1. The southern kelp gull (*Larus dominicanus*), a subantarctic sea bird of circumpolar range, which breeds in numbers in Tierra del Fuego and upon ice-covered, heavily glaciated islands such as South Georgia and Kerguelen, also extends its breeding range along the tropical western coast of South America practically as far as the Humboldt Current is in contact with the land. Its northernmost breeding station, on Lobos de Tierra (6° 25′ S.), is, moreover, *one of its centers of maximum abundance.* On the Atlantic side of the continent the kelp gull apparently nests only south of the Rio de la Plata.

2. The white-breasted cormorant, or *guanay* (*Phalacrocorax bougainvillei*), the first in importance of the Peruvian guano birds, is a member of a well-defined, antarctic branch of the cormorant family. Its close kin are cormorants of the Strait of Magellan, New Zealand, various subantarctic islands, and the shores of the Antarctic Continent, while its relationship with other cormorants of South America or with those of the northern hemisphere is relatively remote. The range of the *guanay* extends along the west coast from central Chile to within six degrees of the equator.

3. Diving petrels (Pelecanoididae), representatives of a typically subantarctic family of marine birds, breed along the western coast from Cape Horn to the northern Peruvian islands (6° 25′ S.). In no other part of the world

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[34] Coker, The Fisheries and the Guano Industry of Peru, p. 338.

are diving petrels known to breed north of about latitude 37° S. (viz. at Tristan da Cunha).

4. Penguins (genus *Spheniscus*) occur northward along the west coast to latitude 6° S., and an endemic species (*S. mendiculus*) resides on the Galapagos Islands, which are crossed by the equator.

5. The southern sea lion (*Otaria byronia*) is permanently resident along the west coast from Cape Horn to northern Peru, and a representative of the same genus occurs at the Galapagos.

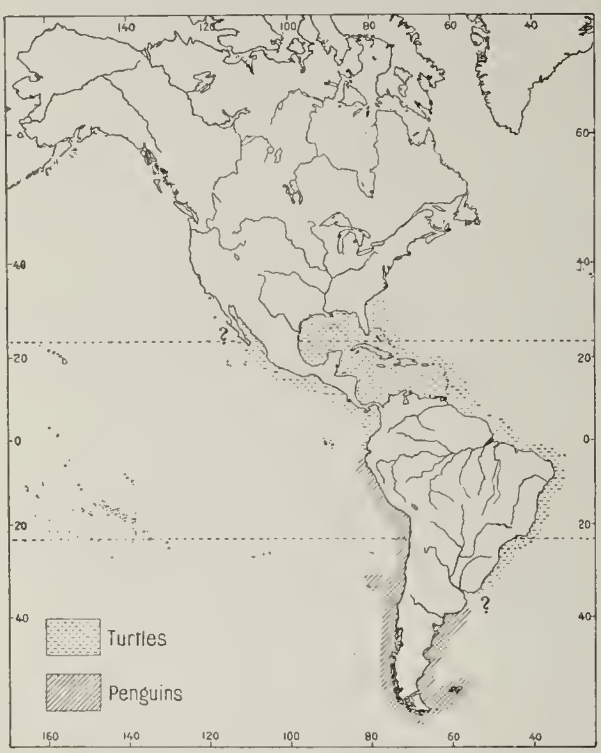

FIG. 4

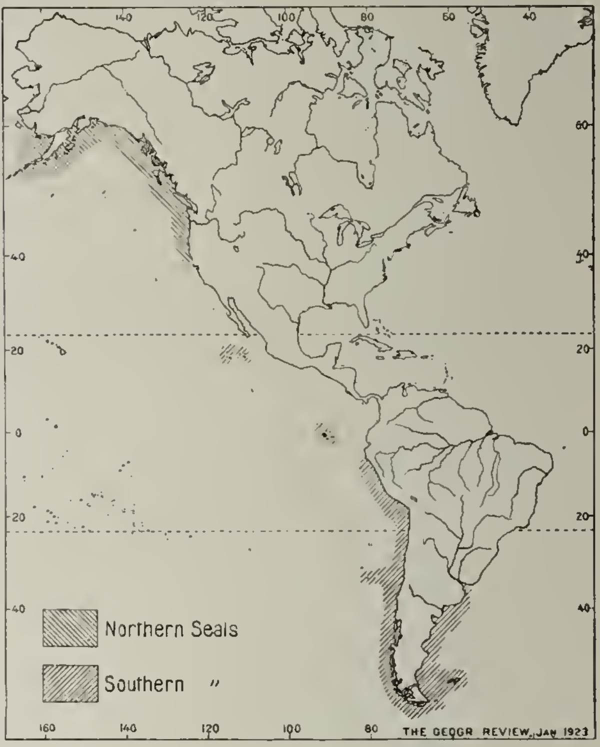

FIG. 5

FIG. 4—Breeding ranges of penguins and of sea turtles, the former determined by low, the latter by high ocean temperatures.

FIG. 5—Ranges of fur seals: the northern genus, *Callorhinus;* the southern genus, *Arctocephalus.* It is noteworthy that no fur seals occur in the warm waters littoral between northern Peru and Lower California.

6. The rare southern fur seal (*Arctocephalus australis*), recently noted by the writer at Independencia Bay, formerly ranged from Cape Horn to northern Peru and the Galapagos, throughout the path of the Humboldt Current. This genus, moreover, has succeeded in "jumping" the northern hydrographic barrier, for a related species (*Arctocephalus townsendi*) is resident off the Lower California coast and may still exist at Guadalupe and San Benito Islands (beyond 28° N.). The latter range, it should be observed, is north of the zone of tropical sea water, in which, of course, no fur seal is to be found.

7. In a similar manner, the southern sea elephant (*Mirounga leonina*) formerly occurred northward along the Chilean and Peruvian coasts to a point now indeterminable. An example has recently been reported from Ilo, Peru. This strange genus of seals reappears, like the fur seal, in the analogous littoral region of the California Current, where the northern form (*M.*

angustirostris) formerly ranged from Cape Lázaro, Lower California (24° 40′ N.) to Point Reyes, north of San Francisco.

In correctly attributing the range of these various animals and of their food supply to the influence of the Humboldt Current, it is easy at the same time to fall into a common error. Thus Boubier,[35] referring to the striking case of the distribution of penguins, states that cold currents not only maintain a low surface temperature and also probably assist in reducing atmospheric temperature (the isotherm of 20° C. roughly limits the distribution of penguins) but, what is more important, they transport an enormous mass of antarctic plankton upon which the birds feed. The organisms constituting this plankton live only in the cold waters, so that when the currents become warmed by traversing tropical seas before returning south (as along eastern coasts of the southern continents), they lose their antarctic plankton. Penguins are accordingly absent from these coasts.

The misconception here is not with regard to the main thesis of penguin distribution but in the idea that low surface temperatures and subantarctic plankton content are due to the transportation of surface water from high latitudes. It has been shown above that the temperature is accounted for by upwelling, which is very marked and very uniform, along great stretches of the western continental coasts. The conception of great "oceanic rivers," bearing northward the cold water and the living cargo of subantarctic seas, is altogether imaginary. The currents are at best extremely lethargic as compared with rivers of the land. The organisms that inhabit them do not originate in the far south, unless it be in an evolutionary sense, but are born, live, and die in the middle or low latitudes where they are found. It is not, in short, that the cold currents carry individual organisms across the temperate zones and into the tropics but rather that the vertical circulation produces life conditions, in narrow littoral belts, which resemble those of antarctic and subantarctic seas. The difference, in actual transporting power, between the deep, cold currents and such rapid surface currents as the Gulf Stream should be emphasized again.

As the Humboldt Current is a narrow stream, it need hardly be added that the composite range of the endemic marine fauna of the Peruvian coast is likewise a narrow ribbon of ocean, hugging the shore and projecting toward the equator from the far south. The facts were first suggested by Ortmann[36] in his studies on the distribution of marine decapods, but the larger implications have been steadfastly ignored by most zoögeographers. If we sail off shore across the current, we encounter a change in fauna which is closely correlated with change in surface temperatures; after a few miles the rich plankton, the sea lions, the penguins, cormorants, kelp gulls, and subantarctic petrels—an aggregate of thousands of species—all disappear. A new oceanic region with a distinctive fauna, rich in species, perhaps, but poor in the relative number of individuals per unit of space, spreads away across the vast expanse of the tropical South Sea.

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[35] M. Boubier: La distribution géographique des manchots (Sphéniscidés) et son interprétation géophysique, *Rev. Française d'Ornithologie*, Vol. 11, 1919, pp. 131–136.

[36] A. E. Ortmann: Grundzüge der marinen Tiergeographie, Jena, 1896.

The hydrographic and biological status of the tropical ocean to the northward of the Humboldt Current is even less well known than that of the Peruvian littoral. Although lying almost entirely north of the equator, this region is in barometric and thermal features the real equatorial belt of the eastern Pacific. The warmest surface temperatures are found north of latitude 5° N., the maximum isotherm moving up toward the Gulf of California during the summer. With the scanty data available, it is impossible to determine the full extent to which this zone acts as a biotic barrier. We have seen, however, that two genera of seals have succeeded in passing it. Recent studies upon the Peruvian littoral fishes,[37] moreover, show that the assemblage has its closest zoölogical affinities with the fishes of the Californian littoral and that both faunae have a pronounced Mediterranean facies.

A type of discontinuous distribution approaching "bipolarity" is produced in certain instances by the oceanic system of the west coast of America. An example is offered by *Emerita analoga*, a small decapod crustacean of the family Hippidae inhabiting a narrow strip of sandy beach within the wash of the waves. The distribution of the species is from Oregon to San Bartolomé Bay, Lower California, and from northern Peru to Chile. The intermediate zone, between Lower California and Ecuador, is occupied, as might be expected, by a tropical species (*Emerita emerita*) which occurs also along warm shores of the Atlantic side.

The antarctic giant kelp (*Macrocystis pyrifera*), the largest of seaweeds, which ranges elsewhere along the western coast of America from Cape Horn to Alaska, has not been reported from a hiatus between Lower California and northern Peru, i. e. the northern and southern points, respectively, at which the effect of cold currents ceases to be considerable. Conversely, this warm belt circumscribes the eastern Pacific breeding range of sea turtles, none of which, so far as the writer has been able to learn, deposits its eggs on beaches south of the Gulf of Guayaquil (3° S.), or north of southern Lower California. On the Atlantic coast the breeding grounds of these chelonians extend from Virginia to southern Brazil or beyond. The sea snakes (Hydrophidae) are likewise confined in their distribution along the western coast of America between 4° S. and 20° N., while the coastal range of crocodilians is entirely between the equator and the Tropic of Cancer. Finally, the distribution of reef corals along the Pacific coast is limited to the region between 4° N. and 21° N., whereas on the Atlantic side of the continents of America the range is bounded by the parallels of 22° S. and 34° N.[38]

Such are the conditions which illustrate an oceanic phase of the far-reaching interrelations of nature and show how pelagic circulation is the beginning of a system which so fundamentally affects both the dispersal and the limitation of marine life. It is not the writer's purpose to discuss here the moot subject of the effect of the Humboldt Current upon the distribution of terrestrial organisms along the Pacific coast of South America. Ashore, on the seaward slope of the Andes, we encounter complex climatic factors wherein the relative weight which should be given to oceanographic influences and to circumstances of purely continental meteorology, in the interpretation of such terrestrial distribution, is still open to question. Whatever a study of the facts may yield, it is significant that a very large number of land animals parallel the marine life of the Humboldt Current, inasmuch as they extend their ranges northward toward the equator in the narrow strip of coastal desert which faces from the mountains toward the Pacific.[39]

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[37] J. T. Nichols and R. C. Murphy: On a Collection of Marine Fishes from Peru, *Bull. Amer. Museum of Nat. Hist.*, Vol. 22, 1922, pp. 501–516.

[38] The northernmost coral reef in the world lies off Beaufort, N. C.

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[39] Cf. F. M. Chapman: The Distribution of the Swallows of the Genus *Pygochelidon*, *Amer. Museum Novitates No. 30*, 1922 (especially pp. 11–15, with distributional maps).

THE FRENCH IRON INDUSTRY AFTER THE WAR*

By Jacques Levainville

In 1914 before the World War the iron industry of France presented the example of a perfectly stabilized activity. In the several parts of the territory where the industry was installed its particular aspects were in harmony with geographical conditions. The establishments of central France situated on the coal fields of the Loire, Saône-et-Loire, Allier, and Nièvre had given up the manufacture of cheap goods in favor of articles of superior quality and higher price—war material, high grade steel for automobiles, and tools. The furnaces of the north were for the most part concentrated round the coal basins of Nord and Pas-de-Calais. In earlier days they had engaged in the production of rails, girders, and ironmongery, but they were turning in increasing degree to the elaboration of more finished products. On the other hand the industry in the east situated on the greatest iron ore deposit of Europe, the Lorraine minette, had specialized almost entirely in the fabrication of primary products—rails, bars, wire rod, sheet iron. The eastern region produced 49 per cent of the steel fabricated in the whole of France. The central, northern, and eastern sections together manufactured 89 per cent of finished products. Outside of these centers the most important iron works were situated in the ports—Dunkirk, Calais, Boulogne, Caen, St. Nazaire, Bayonne—where Spanish and African ores were smelted with English coal. Finally, at many other places force of tradition, skill of the workers, certain advantages of geographical situation had maintained minor manufactories in spite of competition. These plants and those of the seaboard were devoted to special productions and thus were rivals of the central establishments.

Similarly the commercial situation showed a harmonious development. The total French production of 5,200,000 tons of pig iron and 4,686,000 tons of steel was consumed almost entirely by the home market. Our exportations comprised chiefly rails, bars, and sheet metal; our importations comprised machines and tools. We offered an important market for foreign metallurgy. From 1910 to 1913 German importations into France in this branch of industry had increased tenfold, English importations fourfold, and American fivefold. On the other hand our exportation of automobiles had attained great figures. In absolute value our commercial balance sheet showed a relatively small deficit. If the situation then was one of prosperity the future promised still better. Blast furnaces under construction in the northern section and in Normandy were planned to increase the annual production of cast iron by 1,000,000 tons in five years.

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* A summary account from the last chapter of the author's book, "L'industrie du fer en France," Collection Armand Colin, Paris, 1922.

War was declared at a moment when the progress of French metallurgy was in full swing and when, on the other hand, a critical situation was threatened in Germany. In that country the question of iron supply, the progressive invasion in foreign markets by American products, and overproduction by the newly erected plants were causing alarm among the Westphalian ironmasters. Invasion of France offered a means of relieving this disturbing situation: new needs would be created by systematic destruction, French competition would be annihilated, and the famous deposits of French Lorraine (Briey and Longwy) unknown in 1870 would be acquired. The iron question determined the plan of attack. Hostilities began only when the Briey basin was invaded. Then the neutrality of Belgium was violated with the object, successfully realized, of seizing the coal fields of Nord and Pas-de-Calais. France found herself deprived of 90 per cent of her ore production, 68 per cent of pig iron, and 78 per cent of steel. Herr Schrodter was certainly speaking with a clear knowledge of the situation when he declared before the Verein Deutscher Eisenhütte in January, 1915, that the French metallurgical industry was seriously crippled, perhaps even partially destroyed.

It is well known how French energy solved the problem of repairing this damage without waiting for the end of the war.

The treaty of peace placed France in a position of incontestable mastery over the ore market, though without giving her coal resources equal to her needs. Consequently, our iron industry finds itself in an entirely new situation and for the time being has lost its equilibrium. Table I summarizes the chief elements in the problem.

TABLE I—SITUATION OF THE IRON INDUSTRY OF FRANCE

	PRODUCTION IN 1913 (*Unit, 1,000 Metric Tons*)			
	FRANCE	LORRAINE ANNEXÉE (MOSELLE)	SARRE	TOTAL
Raw Materials				
Coal (not including lignite)	40,129	3,795	13,218	57,142
Coke	4,027	91	1,900	6,018
Iron ore	21,919*	21,135		43,054
Unfinished Products				
Pig iron	5,207	3,870	1,371	10,448†
Steel	4,686	2,286	2,079	9,051‡
Finished Products				
Iron	406			406
Steel	3,186	2,027	1,652	6,865

* Not including 1,926,000 tons of Algerian and Tunisian ore.

† To this should be added 400,000 tons from the blast furnaces erected in Caen and Rouen during the war.

‡ To this should be added 600,000 tons produced by steel plants erected during the war.

The Raw Materials

COAL

In 1913 the production of coal in France amounted to 40,000,000 tons, consumption to 62,000,000 tons. Either as coal or coke the metallurgical industry absorbed 12,545,000 tons, or about 20 per cent of the total. Since the war the situation has become still more unfavorable from this point of view. Invasion deprived us of 50 per cent of our production, while 26 per cent more was within cannon range of the enemy. Restoration at the close of the war by no means meant complete recovery; production in 1920 was scarcely more than 29,000,000 tons. In compensation for the destruction the coal mines of the Sarre basin were ceded to France; but the Sarre coal is not well suited for coking purposes. Before the war the metallurgy of Meurthe-et-Moselle (in which *département* lie the Briey and Longwy deposits) consumed 3,500,000 tons of coke a year, of which 1,200,000 tons came from Pas-de-Calais, the rest from Westphalia, none from the adjacent territory of the Sarre. In Lorraine Annexée, now Moselle,[1] of the 4,900,000 tons of coke used

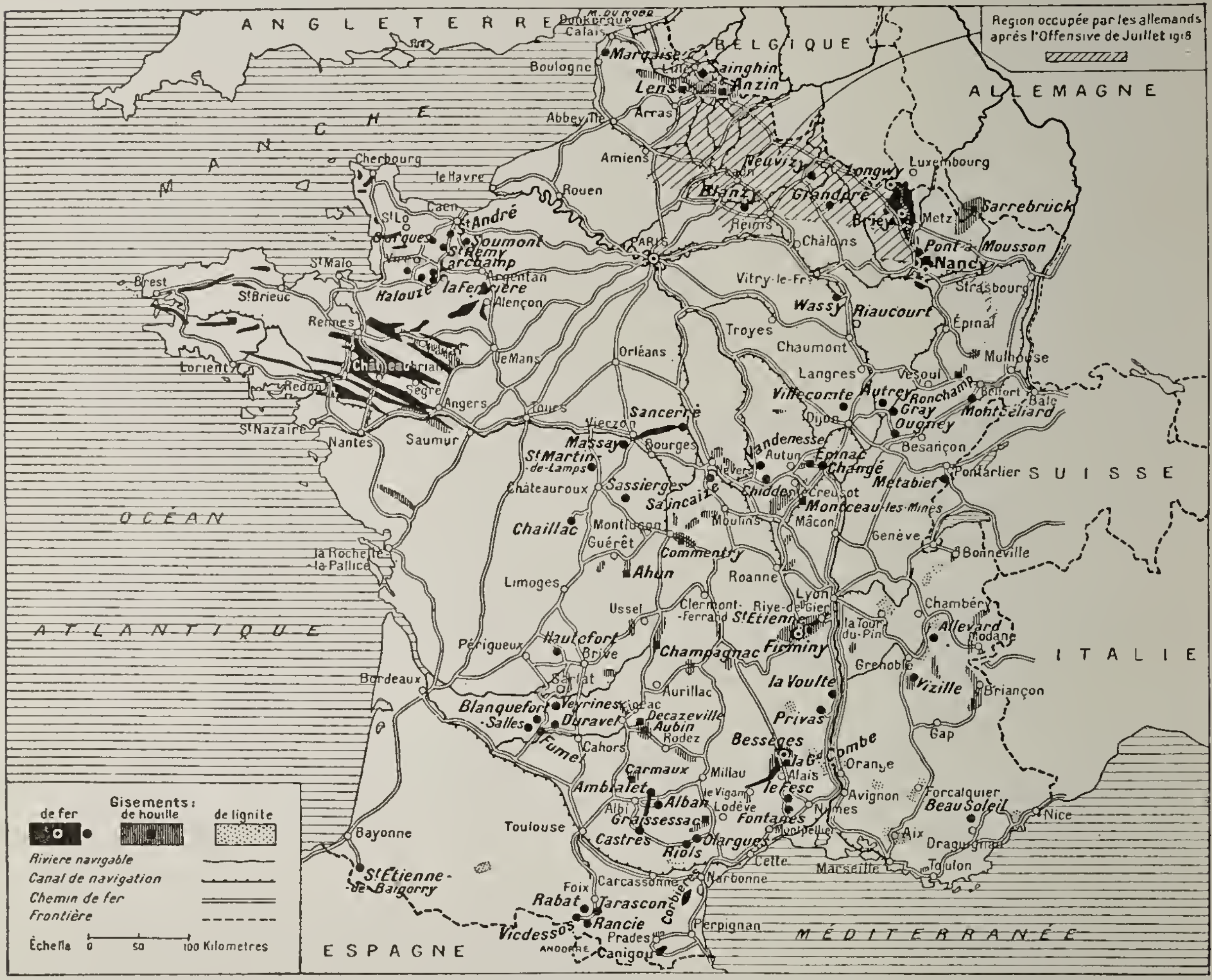

FIG. 1—Coal fields and iron ore deposits of France with chief lines of transportation. After J. Levainville: L'industrie du fer en France, Collection Armand Colin, Paris, 1922.

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[1] The restored provinces of Alsace Lorraine have become the *départements* of Bas-Rhin (Lower Alsace), Haut-Rhin (Upper Alsace), and Moselle.

three-quarters was from Westphalia; the remainder from various sources of which the Sarre was only one.

The mines of the Sarre do not solve the coal problem. On the contrary, it has been aggravated by the addition of the metallurgical industry of Moselle. The prewar deficit of 20,000,000 tons of coal and 4,000,000 tons of coke—reckoning a return of our coal fields to their normal production—will be replaced by a deficit of 16,000,000 tons of ordinary coal and 10,000,000 of coking coal. To assure the indispensable supply of coke for French metallurgy our technicians demanded from the Peace Conference a share in the Westphalian coal. This was not obtained.

In 1913 our importation of coal was valued at 536,000,000 francs, which went to enrich our neighbors and against which our exportation of ore was an insufficient counterbalance. The war has not changed this situation. In 1920 we paid over 400 francs a ton for coking coal, while it was sold in England at 84 francs and in Germany at 72 francs. It is especially the plants of Moselle that suffer from the deficit. The ores of Moselle are inferior in yield to those of Meurthe-et-Moselle. The output of the blast furnaces is inferior in that degree, and the consumption of coal is proportionally high. At the present time certain plants of Moselle use 1500 kilos of coke to the ton of pig iron, whereas in 1913 in Meurthe-et-Moselle 1000 kilos was considered the average consumption. Before the war these differences were of little importance. Unlike the textile industry of Alsace, which had remained in the hands of French families, the metallurgical industry of Lorraine Annexée, the establishments of Wendel being excepted, was entirely under the control of German concerns. Most often they were connected with the great metallurgical plants of Westphalian owners of Ruhr coal fields whence fuel was sent to Moselle. Coke could then be obtained at a better price here than in Meurthe-et-Moselle. These advantages disappeared with the signing of the peace treaty. The price of coal was the same on either side of the old boundary; and in the last analysis the pig iron of Moselle, which consumes the greater quantity of coal, is the more costly to produce. As before the war the question of fuel will dominate the future of our metallurgical industry.

IRON ORE

As a consequence of the war France far outranks all the European powers in her iron ore resources. In fact from the viewpoint of practical exploitation she is only surpassed in this respect by the United States. Her reserves amount to seven milliard tons without counting the considerable colonial deposits. On the basis of present exploitation and on the assumption that deposits will not be worked to a greater depth than 500 meters and that no new discoveries will be made it will take 136 years to exhaust these reserves. Impressed by these figures some of our economists have asked if it would not be well to leave to a distant date the exploitation of certain of our deposits—the ores of Brittany and Normandy, Algeria and Tunisia for example. Without commenting on the expediency of this measure it will suffice to recall the past of our mining industry.

The discovery of Henry Bessemer called for ores of a high degree of purity, in particular for ores free of phosphorus content. France was poor in ores of this character and consequently lost her world place as an iron producer. During the years from 1860 to 1870 a great number of furnaces shut down, notably in Brittany and Normandy; others continued only by importing foreign ore. Such was the state of our industry when, in 1880, Thomas and Gilchrist discovered the basic process for reduction of ores with a high phosphorus content. Forthwith the French ores assumed such importance that ironmasters of foreign countries hastened to acquire concessions in our fields.

Now no one can tell whether in consequence of some such scientific discovery, or some new line of transportation, deposits today of little value because too impure or too far from industrial centers will become exploitable in the future. What happened in the case of the phosphoric ores may happen in the case of the abundant siliceous ores or the arsenical ores long neglected but already beginning to enter into industrial use in the United States. "It is quite evident," writes M. Cayeux, of the Collège de France, "that often, if not always, there is an optimum period for the exploitation of bulky commodities and their market, of which iron ore is an example. To reserve them for a better but doubtful future, in any event long distant, is to leave the substance for the shadow, to let pass the moment ripe for exploitation." The French ores are passing through this optimum period, for our neighbors are short of this raw material.

In Spain the celebrated deposits of Bilbao which for so long supplied the European steel mills appear to be on the point of exhaustion. In 1912 the reserves amounted to some 60,000,000 tons. Other deposits yield a low percentage of iron, as in the provinces of Oviedo and Valencia, or possess a very high phosphorus content, as in the province of Léon. It would be rash to count on a reserve of more than a milliard tons for the entire peninsula.

Although Italy equipped a number of electrical furnaces during the war, her own ore production is limited to the deposits of Elba, and she is forced to import. She will be one of our customers in the future.

Belgium, on the contrary, in spite of her very modest area occupies a position in the front rank of the world's iron industry. She produces per head of population almost as much as Germany (278 kilos against 294 kilos), more than England (226), and more than double France (120). This enormous production is due in part to her abundant coal resources but especially to the excellence of her labor, able and hardworking in spite of low wages. Her ore deposits, a continuation of those of Lorraine, cover 354 hectares. She also imported before the war 6,000,000 tons of ore, four-fifths of which came from Meurthe-et-Moselle, the rest from Luxemburg and Lorraine Annexée.

"In England," wrote M. Tribot-Laspière in 1917, "the dominant charac-

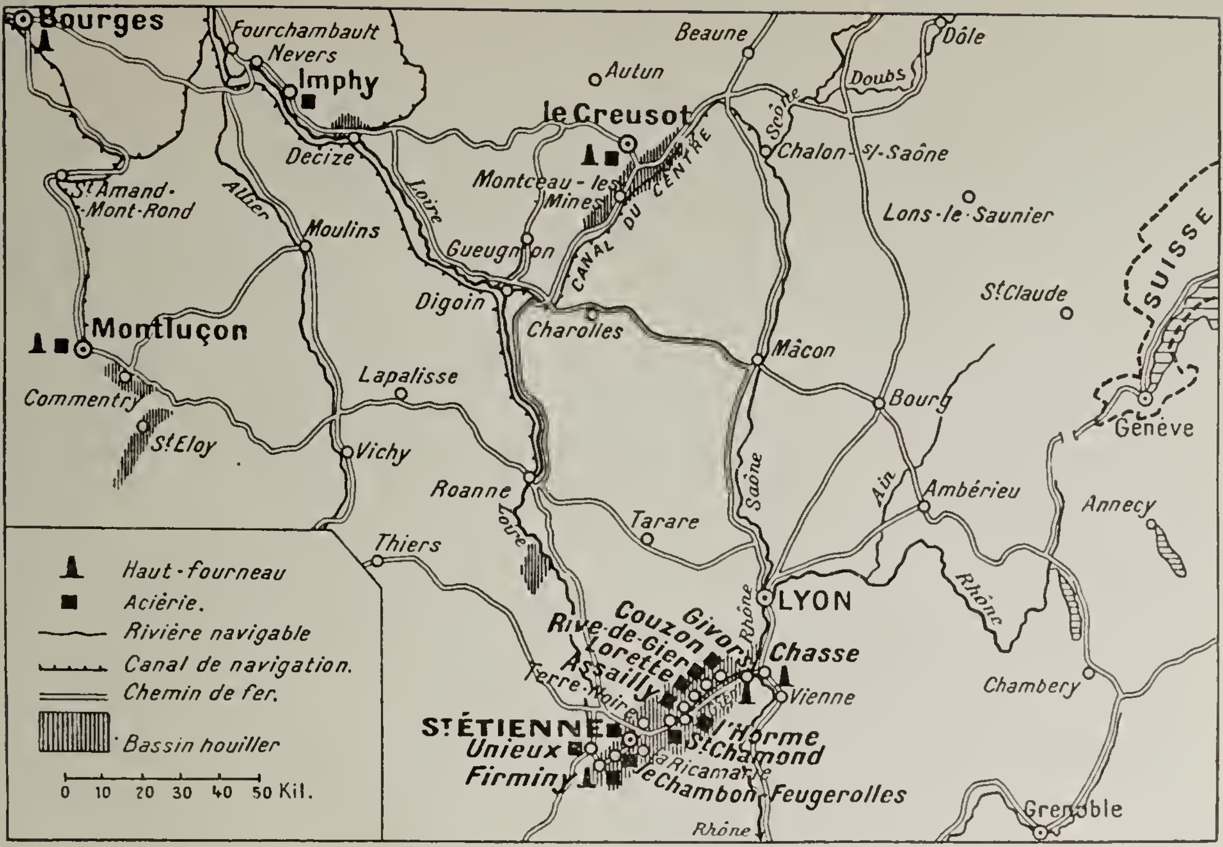

FIG. 2

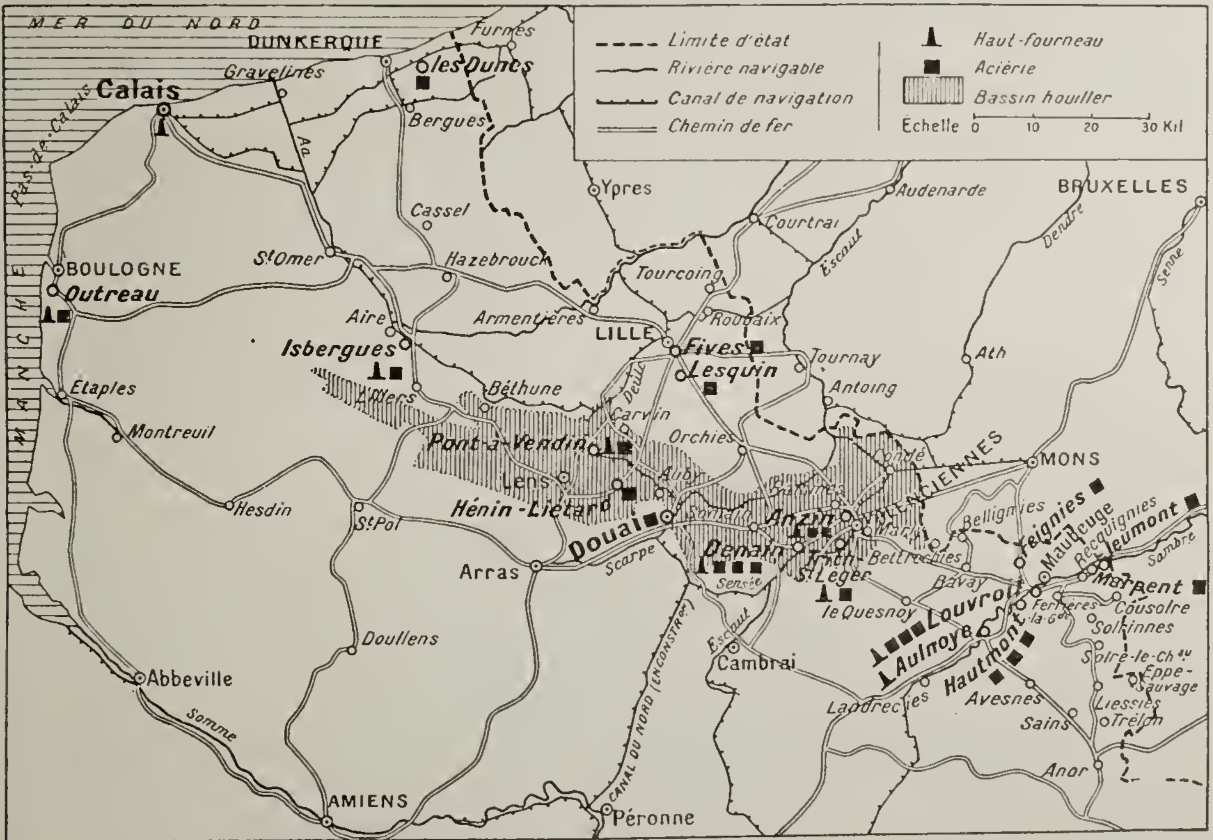

FIG. 3

FIG. 2—The metallurgical region of central France. Coal fields, blast furnaces, and steel mills and transportation lines are shown. After J. Levainville: L'industrie du fer en France, Collection Armand Colin, Paris, 1922.

FIG. 3—The metallurgical region of northern France. Coal fields, blast furnaces, and steel mills and transportation lines are shown. After J. Levainville: L'industrie du fer en France, Collection Arman, Colin, Paris, 1922.

teristic of the iron and steel industry is the present check in its progress . . . for a long time it has been outdistanced by the United States. Germany, in its turn, has risen to second place in production of ore, cast iron, and steel and threatens to arrive at an equal position in coal production." This decline is due in part to low domestic consumption, the isolation and routine methods of the English metallurgists, but most especially to exhaustion of the ore deposits. The English reserves are estimated at 455,000,000 tons; on the basis of the consumption in 1913, 24,000,000 tons, they will be exhausted in 20 years. More than a third of the necessary ore is imported, 7,600,000 tons in 1919, chiefly from Spain and Africa. It is only a transportation problem that prevents import of the Lorraine minette, which differs very little from the Cleveland ores. Our waterways are not economically available for ore transportation to the North Sea or Channel ports. Our nearest and most certain markets have always been found in Germany.

In 1910, at the Geological Congress at Stockholm, the reserves of the German Empire were reported as 3,600,000,000 tons. But in the first years of the war the value of this estimate was singularly diminished. To demonstrate the national necessity for the annexation of Briey the German metallurgists did not hesitate to avow their poverty. On December 8, 1917, before the Verein der Deutschen Eisen und Stahl Industriellen, the president declared, "Granting that the extraction from our mines follows the normal course of progress and that no artificial reduction is imposed, we shall see the exhaustion of the Lorraine deposits in 49 years, the spathic deposits of Siegen in 42 years, the red hematite in 66 years, and in 32 years the hematite of Lahn and of Dill. In 90 years we shall have almost entirely exhausted our resources. Germany must therefore be assured of foreign supplies. Thereon depends the existence of the industry, of the state, and of the people."

In 1913 the Zollverein (Germany and Luxemburg) produced 19,300,000 tons of pig iron from 39,911,000 tons of native ore and 11,000,000 tons of foreign ore. Yet the native ore yielding 31 per cent of iron could only furnish 10,500,000 tons of the product. The remaining 9,000,000 tons, or 46 per cent of the total, was produced from imported ore; or 80 per cent if one classes in this category the 8,600,000 tons of metal obtained in the Sarre and Westphalia by the smelting of imported minettes from Moselle and Luxemburg.

As a result of the war the German reserves were diminished by over 50 per cent in the restoration to France of the 1,830,000 tons of minette in Moselle. Prospecting recently undertaken in the region of Amberg and the Swabian Jura has not revealed compensatory deposits. On the basis of the above the German resources will be exhausted in 25 years. Reduced to an annual production of 2,700,000 tons of pig iron from domestic ore (8,000,000 tons of ore yielding 33 per cent iron), Germany will be forced to import considerable quantities of ore if she wishes to satisfy the national market of 12,000,000 tons of pig iron in 1913.

Without counting possible trade with the Netherlands where blast furnaces have been installed, with Italy with its hydro-electric establishments, with the United States which seeks our ore as return freight for coal, and basing our estimate solely on our assured relations with German, English,

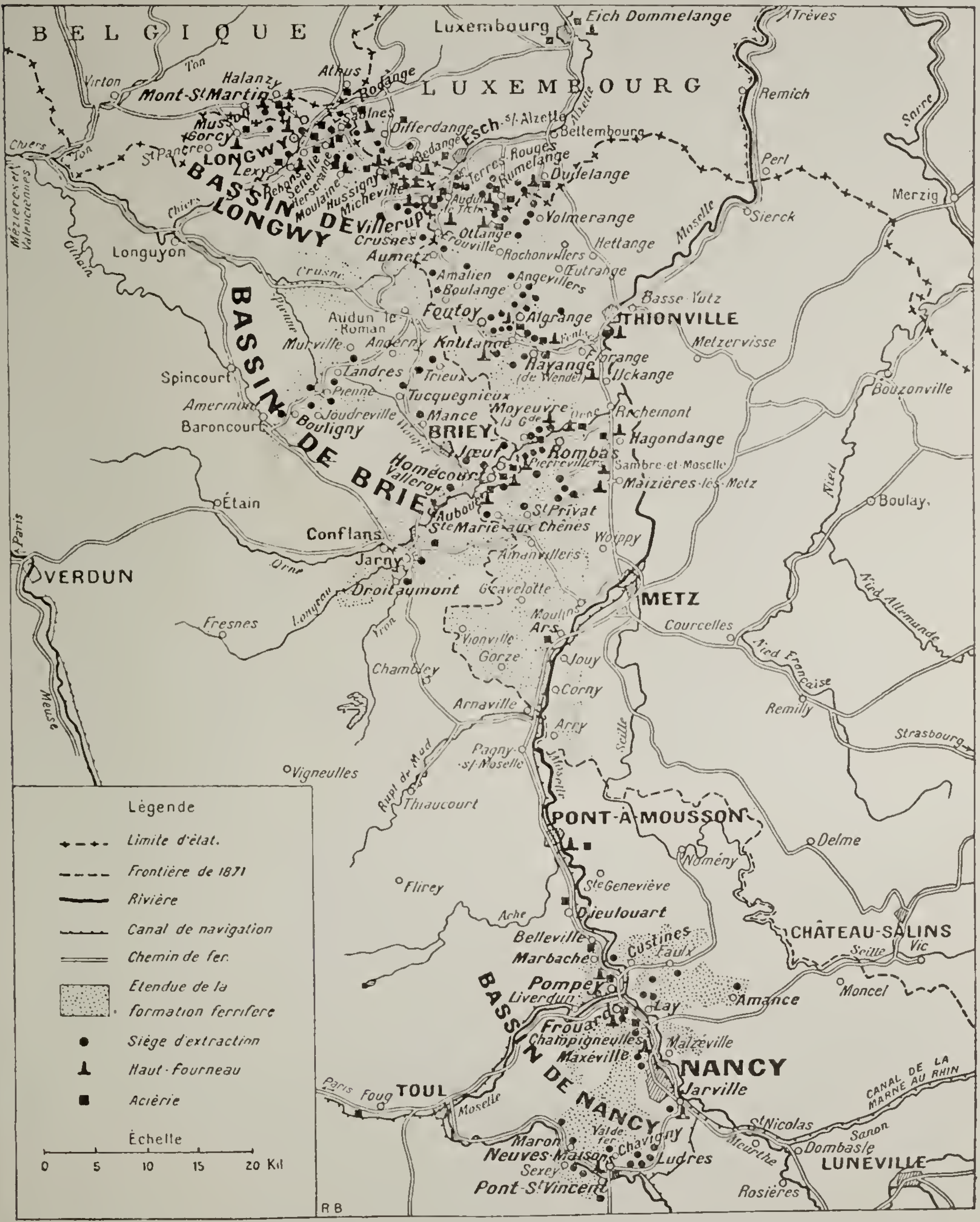

FIG. 4—The metallurgical region of eastern France. The extent of the iron-bearing formation, mines, blast furnaces, and steel mills and transportation lines are shown. After J. Levainville: L'industrie du fer en France, Collection Armand Colin, Paris, 1922.

and Belgian metallurgists it is not unreasonable to estimate our ore exports of the near future at 17,000,000 tons. In this respect the prospect is satisfactory; it is otherwise with the commerce in pig iron and steel, especially in the latter.

Metallurgical Production

When the plants of the northern and eastern districts are restored to normal conditions, France, including the production of the Sarre basin and Moselle, will be in a position to put on the market 11,000,000 tons of pig iron and 10,000,000 tons of steel a year. Should the Sarre territory be returned to Germany at the end of the 15-year period of French control, these figures will be reduced to 9,400,000 tons of iron and 8,000,000 tons of steel. We have seen that in 1913 domestic consumption was about equal to production. On the other hand, Moselle and the Sarre being quite unable to absorb their own production, French metallurgy will have to dispose of an important surplus. The situation is liable to deplorable results, which can only be avoided by judicious adjustments between the domestic and foreign markets.

The French Market

An increase in the home market is very probable. In France the consumption per head of population of pig iron (100 kilos) and of steel (90 kilos) is less than in any other nation engaged in metallurgical industry. In particular increase may be expected in the use of structural products and in machine construction. France, though rich in a variety of building materials, has limited herself largely to the use of stone and wood. Of structural steel we may expect an increased consumption of about 400,000 tons. But it is especially in machine construction that the largest gain may be looked for. Many industries are already expanding in this field. The automobile, for instance, is not used in France to the same extent as in England, while in neither country is it employed to anything like the same degree as in America. Statistics show one car for 400 people in France against 300 in England and 11 in the United States. The Committee of Arts and Manufactures estimates that machine construction will increase 79 per cent, corresponding to a demand for 1,000,000 tons of metal. A total of 1,400,000 tons for increased domestic consumption leaves 2,865,000 tons to be placed on foreign markets.

Before the war England exported 43 per cent of her production, Germany 33 per cent, Belgium 90 per cent, France only 10 per cent. It is in this respect that our industry is most susceptible of development.

The European Market

The victory of the allied armies led one to anticipate an easily found market in the neutral countries which had previously bought from Germany. As regards the iron industry, at least, our hopes have not been realized. Already favored by the price of coal, the German metallurgists are equally favored by the cost of labor. "In France," wrote M. Albert Despeaux in 1921, "the wage rate has more than quadrupled since 1914. In Germany, expressed in the mark, it has been multiplied by 10 or 11; but, as the mark in relation to the franc has less than one-seventh of its prewar value, German wages have only increased by 100 to 150 per cent." In consequence, in Germany at this date iron was quoted at 1700 marks, or 260 francs (6.5 marks to the franc) the ton; in France at 400 francs.

Among the important consumers of German iron and steel products Great Britain is the one that offers the best market for our industry. At first glance it seems paradoxical that we should attempt to capture a market for the manufactured product in a country which buys from us large quantities of raw material. But it must be remarked that before the war Great Britain absorbed 1,200,000 tons of German iron goods, principally the output of Lorraine and the Sarre—semi-finished products, structural steel, and sheet iron. Furthermore, as regards the question of wages, the situation with us which compares unfavorably with Germany is, on the contrary, favorable as compared with that in Great Britain. After the armistice, in consequence of the coal crisis, of strikes, and of the rise in freight rates, the English steel manufactories were forced to import pig iron from Luxemburg and Normandy, whence, in spite of transportation costs, it could be obtained at a less price than at home. Here is an indication of the road we should pursue. By taking it we may liquidate a part of our debt for English coal.

The Extra-European Market

In the other markets struggle will be keen. Competitors more advantageously situated have arisen during the war. The metallurgical power of the United States has developed to a formidable degree. Already in 1913 the production of iron amounted to 31,000,000 tons and was almost entirely absorbed by the home market; in 1918 the production figure had risen to 39,000,000 tons and was disposed of in its entirety. Since then new blast furnaces have been built capable of an output of 45,000,000 tons, or 60 per cent of the total world production in 1913. This rapid growth has caused a changed orientation of commercial policy. As home consumption has been satisfied, exportation has grown; and metallurgical products today provide American shipping with cargoes of the first order of magnitude. In 1920 they amounted to 4,000,000 tons. During the war this export was mainly to the allied countries—France, Great Britain, and Italy. The signing of the armistice and the crisis in exchange put a restriction on sales to Europe. Export was then to the countries where exchange was more favorable, to markets most often gained at the expense of the English iron trade.

In 1920 Japan was furnished with 613,000 tons of iron by America, by England with only 116,000 tons. In their own colonies the English also have encountered serious competition. In this same year England sent Australia and New Zealand 187,000 tons, while America sent 52,000 tons; the figures are 221,000 tons and 74,000 tons respectively for India; 57,000 and 38,000 for South Africa.

At present the United States is the only metallurgical power in the New World but a development is beginning in other countries which will ultimately close them to foreign importations, notably in Chile and Brazil where capital from the United States is active. The time can be foreseen when the American markets will be closed to European industry.

Similarly the European war gave impetus to the creation of an iron industry in the modern sense in Asia and Australia. In Japan the project of erecting blast furnaces for an annual production of 1,500,000 tons of iron has not been realized in spite of financial assistance from the state. The present tendency of the Japanese industry appears to be towards establishment of manufactories on the continent in reach of the deposits which feed the steel mills of the archipelago; in Korea and in Manchuria, where Russian competition has been in evidence; in China, where the associations of Sino-Japanese capital compete for concessions with Sino-American capital. Equally in India the last few years have shown a remarkable development in iron and steel. Local consumption is no longer absolutely dependent on foreign supplies.

Australia, which long remained agricultural, appears now to have entered on the industrial period in its evolution. Its first blast furnace was erected in 1913; in 1920, 86,000 tons of iron were produced, an increase of 5000 tons on the production of the preceding year. The department of railroads has undertaken the construction of 20 locomotives. These new industrial developments cannot satisfy all home needs as yet, but they are significant of future possibilities.

Far from the markets of the Orient and Latin America, where we have been outdistanced for the present by competitors more advantageously circumstanced and where we shall be arrested in the near future by the growth of native industry, France can only hope to gain a place for her metallurgy in her African colonies and then only if prospective measures are taken to safeguard her interests. Successfully to maintain the industrial strife, to create new markets, to influence the government and public opinion the several branches of the iron industry must concentrate their forces; they must trend in the direction of integration.

Integration

The process of integration consists in taking the material in its raw state and controlling it through all its stages up to retail sale as finished product. In the iron industry, for example, integration unites under single control the iron and coal mines, the blast furnace, the steel works and rolling mills, the fabrication of machinery and tools, the metallurgical and machine shops, the naval construction yards, the transportation lines, and the mechanism of sale.

The process is not new. Before the war the ironmasters of the northern region, anxious over their stocks of ore, had acquired interests in the deposits of Lorraine, Normandy, Brittany, and even Spain. Similarly the works in the east which lacked coke were assured of a good tonnage from the basins of Nord and Pas-de-Calais, in the Belgian Campine, in the fields of Aix-la-Chapelle, and even in Westphalia. But the most striking fact of the present moment is the amplitude taken by this movement and by its growth in a "vertical" sense.

Before the war the iron industry was specialized according to its location in the national territory. The present alliance between the metallurgists of the central, northern, and eastern sections has had for its objective joint reconstruction of destroyed works, exploitation of the whole mining and metallurgical field, and acquisition of new establishments in the Sarre and Moselle. For example the consortium formed by the Aciéries du Nord et de l'Est, the Société Métallurgique de Pont-à-Vendin, the plants of Espérance et Louvroil, the metallurgical works of Basse-Loire at Trignac has made itself master over the iron and steel works of Nord and of Lorraine, including the plant of Uckange and Neunkirchen. It controls in entirety or in part ore deposits whose reserves are estimated at 350,000,000 tons and whose annual extraction is 4,000,000 tons; coal fields in Pas-de-Calais, Vendée, Belgium, and England; 27 blast furnaces, 4 Thomas steel works, 3 Martin steel works, and 2 electric furnaces; coking ovens, slag grinders, cement works, manufactories of refractory products, foundries, iron works, and construction shops. The establishments of the Sarre and Lorraine furnish the Thomas steel and all the shapes and semi-finished products derived therefrom. The establishments of the Nord elaborate a part of the common products of exportation and of semi-finished products; the works of the Loire turn out finished products for naval construction shops and semi-finished products for exportation.

But integration leads the metallurgical industry to more distant conquests. If questions of freight rates or customs barriers block the free circulation of merchandise, the iron industry may attempt to set itself up in foreign territory.

After the war the Schneider works, whose principal seat is at Creusot, and the bank of the Union Parisienne formed the Union Européene, Industrielle et Financière for the development of economic relations, chiefly metallurgical, between France on the one hand and Czechoslovakia, Poland, and Hungary on the other. The consortium has acquired the control of the iron and steel works of Skoda at Pilsen, of the Société Anonyme des Établissements Réunis (distilleries and sugar refineries), the Société Berg und Huttenwerks, the forges and steel works of Huta-Bankowa in Poland, of the Banque Générale de Crédit Hongrois at Budapest. Finally the Établissements Schneider still share in the Compagnie Française du Levant, in the Framerican Industrial Development Corporation, the Société Espagnole de Construction Électro-Mécanique, the Société Anonyme Officine Metallurgiche Mecaniche de Tortone, the Union Industriale Italo-Francese—without counting interests in Russia, important before the war.

By transforming the economic methods of the iron industry, integration has enormously enhanced its prestige. In France this power is divided up with rare exception among the numerous participating societies. On the contrary, on the other side of the Rhine it is concentrated in the hands of a few captains of industry who are thus enabled to impose their will on the state. It is significant that Hugo Stinnes was the representative of the Republic at Spa and Rathenau at Cannes. Both were at Genoa.

Conclusion

At the present stage the iron industry in France exhibits profound evolution in its economic function. In a comprehensive article[2] in the *Annales de Géographie*, M. Demangeon has shown that our metallurgists were long in throwing off the bonds of the past. On the eve of the Revolution, when metallurgy had become a large-scale industry among our neighbors, it remained a local activity in France. Metal was considered a rare commodity, almost a luxury; its use was confined to domestic utensils, agricultural implements, armaments, and hardware. In France the real iron age, or more exactly the steel age which has replaced it, dates only from the year 1880. In 1871, expounding the clauses of the Treaty of Frankfurt before the French parliament, Thiers declared that the metallurgical prosperity of a country was pure illusion and attempted to demonstrate that the lost territories were without value in this regard.

Handicapped by the lack of fuel our iron and steel industry had difficulty in entering into foreign competition; the domestic market also would probably have been lost but for the protective tariff. As it was, her importations like her exportations were insignificant as regards tonnage. Her industrial rôle was essentially national when war was declared.

The Treaty of Versailles has changed the factors in the problem. The return of Alsace and Lorraine to France raised her to an important world rank in the production of ore and metal, as has been shown statistically. To enlarge her horizon in the field of exportation and take her place in the world market is the next step.

National activity is too complex a thing to be characterized by one of its factors alone, but certainly agriculture is no longer entitled, as once it was, to represent the economic power of the country. "Pâturage et labourage," said Sully, "sont les deux mamelles de la France, les vrais mines et trésors du Pérou." True formerly, this dictum holds no longer. In France the use of iron is the essential element which has marked the great progress of the last fifty years.

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[2] Albert Demangeon: La répartition de l'industrie du fer en France en 1789, *Ann. de Géogr.*, Vol. 30, 1921 pp. 401–415.

THE HALLIGS, VANISHING ISLANDS OF THE NORTH SEA

By W. M. Davis

The estuaries of the Elbe and the Weser, opening in the angle where the shallow North Sea becomes shallower still between the Danish peninsula and the German-Dutch mainland, separate the low, 'longshore Frisian islands into two groups; a baker's dozen of larger islands from 5 to 30 kilometers in length and many little ones constitute the southern group and are known as West and East Frisian according as they belong to Holland or Germany; and about as many similar-sized islands constitute the other or North Frisian group, the members of which were associated with Denmark until the Schleswig-Holstein seizure in 1864 and have been since then mostly Prussian. A large part of the islands in both northern and southern groups, as well as a strip of mainland behind them, consists of salt-marsh land, little above mean sea level, and this suggests a two-chapter physiographic history: first, the construction of a fairly continuous belt of offshore sand reefs, built up from a shallow sea bottom by storm waves perhaps 2000 years ago and enclosing a very shallow lagoon where the marsh lands could be gradually filled in; and then the breaching and destruction of the sand reefs and the exposure of the marsh lands behind them to wave attack as at present. The occurrence of sand beaches backed with belts of dunes along the outer shore of some of the islands gives support to this two-chapter view. The change from the earlier period of sand-reef building and salt-marsh filling to the later period of their destruction is explained by some as the result of a slight subsidence of the region; and by others as the result of an increased range of tides with an accompanying swifter flow of tidal currents in consequence of the widening of the Strait of Dover by centuries of storm-wave action: the two processes may have co-operated.

MÜLLER'S MONOGRAPH ON THE HALLIGS

If one sets out from Blaavands hook, the sharp point on the west coast of Denmark between the continuous shore line of Jytland on the north and the broken shore line of Schleswig on the south, eight islands—Fanö, Mandö, Röm (the German-Danish boundary which ran north of this island before the Treaty of Versailles now runs south of it), Sylt, Föhr, Amrum, Pellworm, and Nordstrand—may be counted in a distance of 130 kilometers on the way to the marshy Eiderstedt foreland, 40 kilometers from the mouth of the Elbe. The islands of this stretch represent all that now remains of the outer part of the original marshland. The destruction is still going on, except where opposed by protective shore works. Around the last two of the above-named good-sized islands, both of which are diked like the mainland border behind them, lie a number of smaller ones, greatly wasted patches of unenclosed marshland. They are known as the Halligs; and to the natural and human history of these and other small islands near by to the south, twenty-one in all, Engineer-Inspector Friedrich Müller of Schleswig devoted a great amount of study for many years of his life. After his death in 1914 his manuscript was revised and published in 1917 by Engineer Eger. It is a most painstaking monograph, replete with detailed information.[1] The first volume treats the Halligs as a group, describing their origin, their inhabitants, their storm floods, and their recent partial protection by shore works. The second volume treats each island separately. An atlas of 23 sheets contains many large-scale maps, in addition to the smaller ones of historic interest in the text. The first map is a section of the Prussian general map of central Europe, 1: 300,000, showing the entire Schleswig-Holstein region. The second gives all the Halligs with their house mounds and tidal channels on a scale of 1: 25,000. The third is reproduced from a German Admiralty chart, 1: 100,000, for the main Hallig district and exhibits the tidal flats and channels in much detail; the fourth is from the same source for the islands farther south. Among a number of reproductions of ancient maps, those of sheets 5, 6, and 7 date from 1597, 1640, and 1649 and thus show the beginning of the changes by which old Nordstrand has been reduced to its modern fragments. These changes are summarized on a chart, 1: 120,000, constructed in 1888, showing the shore lines of that date in red with the restored shore lines of 1643 in black. Other sheets are reproductions in color from minute Danish surveys in 1803 on a scale of 1: 5000. A few charts representing protective works are also given. The following account of the Halligs, although based on Müller's work, contains a number of items from other sources, chiefly from an excellent essay by Traeger,[2] in which geographical matters are appreciatively presented; and also from the Schleswig-Holstein Yearbook for 1922,[3] in which the well illustrated text is devoted to North Friesland, mainland as well as islands.

Physiographic History of the West Coast of Denmark

The level North Frisian marsh islands, separated by broad low-tide flats along the west coast of Schleswig, stand in strong contrast with the rolling hills divided by slender sea arms on the east side of the Danish peninsula. The latter constitute a segment of the latest terminal moraine formed by the lobe of the great Scandinavian ice sheet which crossed the Baltic sea, its western margin here lying about north and south while its southern margin is marked by the Pommeranian belt of morainic hills. From the hills on the east side of the peninsula the surface of Schleswig gradually declines westward as a plain of outwashed sand, interrupted here and there by low hills; fairly fertile at first and then at lower levels given over to barren heaths, until the sands change to clay and dip very slowly under the sea, to be covered by salt marsh as explained above. It is not only to the winds and waves but more particularly to the tides that the earlier construction of the marshland and the later destruction of its outer part are due. As long as a lagoon was enclosed from the shallow sea by the offshore sand reefs, flood and ebb currents probably maintained a number of narrow breaches or tidal inlets in the reefs; if the advancing flood currents were then made turbid with silt lifted from the outer sea bottom by storm waves, they brought the silt into the lagoon, where much of it settled among the seaweeds during high slack water; the ebb currents then ran out somewhat cleared. Since the protection of the sand reefs was lost, the action is reversed: the flood-tide currents, with however much silt they may be charged before reaching a marsh island, become still more heavily charged by attacking the island shore; a good part of the silt thus acquired is swept away by the more turbid ebb currents, and the marsh is slowly converted into low-tide flats. The marshland was probably from 40 to 60 kilometers wide when most fully developed; now its outer part over a breadth of 30 or 35 kilometers is largely converted into islands surrounded by sand and mud flats, which are subdivided by branching tidal channels, very broad for their length as compared to rivers. So slowly does the sea deepen that the line of 20-meter soundings lies 30 kilometers outside of the flats.

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[1] Friedrich Müller: Das Wasserwesen an der Schleswig-Holsteinischen Nordseeküste. 2 vols and Atlas. Dietrich Reimer, Berlin, 1917. 11 x 7½ inches.

[2] Eugen Traeger: Die Halligen der Nordsee, *Forschungen zur Deutschen Landes- und Volkskunde*, Vol. 6, 1892, pp. 227–343. Stuttgart.

[3] E. Sauermann: Schleswig-Holsteinisches Jahrbuch: 1922. Hartung, Hamburg, 1921. This highly characteristic German annual opens with 12 pages for the months illuminated with colored Frisian designs; then come 122 pages of text by different authors, treating various aspects of the region and including a bibliography of 8 pages; at the end are 24 half-tone plates of North Frisian scenes reproduced from pictures by Frisian and German artists

Action of the Tides upon the Halligs

Although the ordinary range of tide is only about three meters, its rise transforms a landscape into a seascape. At low tide the surviving islands, from one to five or ten kilometers across, are like green oases in a flat gray desert of sand and silt of similar breadth. At half tide the flats are covered, and the islands stand alone. At spring high tide only the larger dike-protected islands are kept dry; the undiked Halligs are all under water, except for the artificial mounds on which for centuries past the inhabitants have built their little groups of houses. When an exceptional on-shore storm wind first sweeps the flood current toward the shore and then retards the following ebb until another flood is raised still higher, the sea flows over the islands with double its ordinary rise; for the water being extremely shallow and therefore agitated by wave motion from surface to bottom, the heaping up of the on-shore drift cannot be checked by a compensating outflow beneath, such as is developed by on-shore winds where deeper water fronts the land. Hence at time of such storms even the mounds on the Halligs are drowned, and only the houses, or so many of them as are not broken down and swept away, remain above water, like vessels at anchor riding out a storm.

The exposed western sides of the Halligs are sharply undercut in little bluffs, a meter or more in height and of angular outline; the turf binds the surface silts in a tough bed, which breaks off in slabs as it is undermined. On the eastern side of an island, where abrasion alternates with deposition, the marsh slopes gently into the flats. Each island is subdivided by many little tidal channels, some of which run from shore to shore; at times of storm the channels are widened by rushing currents. Thus exposed to assault from within as well as from without, and not only during storms but also by the continuous action of ordinary tides, the marshlands have been cut into islands, the larger islands of former centuries have been reduced to smaller islands, and some of the smallest have vanished.

House Mounds and Houses

It is believed that the building of house mounds on the marshland was practiced by an ancient people who were established there perhaps 2000 years ago, presumably when the outer sand reefs still held back the destructive storm floods; dike building is thought to have been introduced by a later people, presumably after the sand reefs had been breached and storm floods had become a serious danger. At present, and probably for ages past, the house-bearing mounds, built up of marsh mud dug from near-by pits, have a flat surface, five or six meters above ordinary high tide, and from 50 to 150 meters across at the top. They decline by a gentle slope that measures 20 or 30 meters on its descending breadth, this form being adopted in order to weaken the attack of the waves upon the mounds and houses at time of storm floods. Each mound usually bears from 4 to 10 or 15 houses, set somewhat irregularly; occasionally also a church and a schoolhouse, rarely a tree. The houses measure in plan 8 by 12 or 15 meters, more or less, and are all built on much the same one-story pattern. The brick walls are three or four meters high, with small windows; a steep-slanting roof, thatched or tiled, has its ridgepole seven or eight meters above the ground. Within, a hayloft occupies the roof space and provides the last refuge at time of storm floods; on the ground floor a passage, between rooms on either side with sanded floors and built-in beds, leads to a kitchen. A chimney, with an oven on the kitchen side and a stove on the other, rises above the roof. The dwelling rooms usually face to the south and west, as if to get more sunshine; winter stalls for cattle and pens for sheep and swine are on the north and east. Cattle dung gathered from the pasture fields and dried in the sun serves as the only fuel. Sometimes two or more houses are joined end to end; the number of chimneys then indicates the number of associated families. The house walls are built extra strong on the west side, for there the attack by storm waves is most violent; but the walls are enclosures rather than supports, for inside posts hold up the roof in case storm waves batter the walls down. The western windows have heavy shutters to stand storm-flood pressure, and the outer doors have grooves in their frames to hold bulkheads, packed water-tight when flood tides rise over their sills. The lanes between the houses are paved; also the steps of broad tread and low rise by which the mounds are ascended. The houses now-a-days usually occupy a half or a third of a mound top, and kitchen gardens cover the rest; but it is thought that the present garden space was formerly occupied by houses when the marsh pastures were broader and the mound population therefore larger. One or more small areas in each mound are excavated in shallow pools, with sides of plank, to gather water for the live stock; snow carried into the pools in winter supplements the inflow of rain water from a small dike-enclosed area adjoining the base of the mound. Water is raised by buckets on sweeps or by pumps from the pools to the cattle troughs. A supply for household use is drained from house roofs into cisterns. As the rainfall is only about 700 millimeters a year, the cisterns sometimes run dry; and storm floods occasionally fill the pools with salt water. Fresh water has then to be brought from another island or from the mainland. Recently artesian wells bored to an aquifer 30 or 40 meters deep have yielded good water by pumping.

The marshland is covered with a rich turf of salt grass. The soil is frequently enriched on the undiked islands by silt from the highest tides; occasionally the turf is covered with an inch or two of silt from a single storm flood or buried to disadvantage under deposits of sand and shells swept up by heavy storms. Flowers are abundant in spring and summer; bees are kept in some villages. Ants are a plague; they in some way escape drowning even if several spring tides in succession cover the marsh; but they seem no more discouraged by such catastrophes than the human inhabitants are: the countless ant hills occupy space that cannot be well spared.

Seafaring and Farming

The people of the Halligs, by reason of their constant contact with sea and land for ten centuries at least, are seafarers as well as farmers. They are of Frisian origin and, like the inhabitants of the larger islands and of the mainland marshes, have always kept much to themselves. Some of them are driven elsewhere as the marshland is washed away, but no newcomers ever settle on the islands. The local language, although of old Germanic stock, is not intelligible either to Germans or to Danes; it is akin to English; the seafaring lingo in particular resembles that of English sailors. Today schoolmasters teach all the children standard German. As to seafaring, the men seldom have seaworthy boats of their own, and offshore fishing has never been actively carried on, perhaps because of the difficulty of leaving and making their mound ports through the tidal channels. It has long been the custom, though less generally now than one or two centuries ago, for those who intended to become sailors to gather at a town on one of the larger islands in the early spring and sail thence to Holland, especially to Amsterdam, where they hire out for summer cruises; but they habitually return home for the winter, and as a result the house furnishings include many articles of Dutch manufacture. The returning sailors seek wives from among their own people; and a moderate excess of feeble-minded offspring appears to result from close intermarriage.

As to farming, the occupants of each mound hold the marshland in common for a radius of 500 or 1000 meters around. Part of the marsh is used for pasture, part for hay, divisions being made by ditches. The grass is not all cut at once, lest the entire crop might be swept away by a single spring tide; the cut grass requires from one to three weeks to dry and is then raked up, baled in sheets, and carried to the mounds by boat if tidal channels serve, but more commonly on the heads of the harvesters. Horses are unknown except on some of the larger islands at harvest time and except where certain flats are firm enough for inter-island traffic by wagon. Pasture rights are carefully defined for each family, the unit of area being that needed to support a cow; this unit is reckoned to suffice for two yearlings, four sheep, six calves, and eight lambs. As the sea encroaches upon a Hallig, the pasture rights are diminished all round; a family that had eight units of pasture may lose half a lamb's need per unit, or half a cow's need in all. In summer the cattle are left on the marshes, except that they are daily driven to the mounds to be milked and watered; and also except that during spring high tides they are driven up the mounds and kept in outside sheds. In winter the live stock remains within the houses; their stalls and pens in absence of sufficient straw for litter are floored with planks.

The Life of the People

It may be well imagined that life on a Hallig consists of a simple round of duties. The women are good housewives and keep the living rooms clean and neat in spite of their being under the same roof with the cow stable and sheep pen. The days of summer are busy; many of the men being then at sea, the home members of the family must gather the hay crop and tend the cattle. The days of winter are quiet; for then the marshes are deserted, and the sailormen at home again share not only in the labor of feeding the live stock in the stalls and pens but also in spinning and knitting. A very democratic spirit prevails, as if because the population has long been subdivided into small communities in which every one worked at similar tasks and no one had much more or much less property than any one else. It appears to be chiefly the sailor who, becoming a captain and a successful trader, lays up more wealth than his neighbors. The children are kept at home until they can be trusted to cross the ditch bridges safely. Then they go to a school of rigid discipline on a central mound; but schooling is not carried far. While in their own houses the children are held to strict obedience of parental commands. They have no games, no songs; indeed, among the elders singing is taken as a sign of tipsiness. Little wonder that the men of such a folk are reserved and silent, given to brooding rather than to talking, except when their tongues are loosened with drink. Little wonder that all the inhabitants of the Halligs, fathers and mothers, old and young, are devoutly and primitively religious, all the more so by reason of the dangers to which they are exposed. Their preachers have long exercised much authority among them. Besides the preacher and the teacher, there is an officer charged with the disposition of jetsam found on the shore under traditional rulings, which have become so complicated as to discourage the report of findings. More important is the elected board of three or more members whose duty it is to divide, mark off, and record the strips and patches of pasture and hay land each spring; and, what with changes of rights by inheritance and purchase and with decrease of marsh area by sea encroachment, the labors of this board are arduous. A prevailing skill in numerical reckoning is plausibly ascribed to the need of understanding fractions in the assignment of pasture rights.

Among the great events of the year are the market days, spring and autumn, in the towns of Wyck on the neighboring island of Föhr, or of Husum on the mainland marsh border. Home products are then sold, and supplies are laid in for months ahead. Communication between the little islands is not easy, even in summer; many are the stories of danger and loss of life on the tidal flats, when the rising tide delays progress and fog hides all landmarks. In winter, inter-island traffic is made more difficult by drifting ice in the channels. Not the least of the dangers of isolated life on the Halligs arises from the difficulty of securing medical care when illness comes, for doctors are to be found only in the towns on the mainland or the largest islands, and much time is lost in fetching them. In recent years a telegraph cable has been laid to connect the chief islands, but the little ones are still isolated, unless the telephone has supplemented the telegraph.

Storm Floods

The main epochs in the history of the Halligs are marked by great storm floods; and so overwhelming have the floods been that in the course of centuries many hundred thousands of human lives and millions of cattle and sheep have been lost by drowning. Fortunately it rarely happens that tides and winds combine in such a way as to produce the greatest catastrophe: a spring-flood current running northeast toward the islands must be driven to exceptional height by a southwest gale, and then a shift of the gale to the northwest must oppose the ebb current which tends to run off in that direction and thus allow the second flood to rise still higher than the first.

The catastrophes of the Dark Ages are vaguely known. They appear to have led to the construction of protective dikes in the following centuries. The greatest storm flood of which a definite record is preserved is that of 1634, when, although Holland was little disturbed, the diked island of Nordstrand, then measuring roughly 20 by 30 kilometers, the ancestor of most of the Halligs, was devastated. Its dikes were breached in 44 places, 1300 houses were destroyed, 6000 inhabitants and 50,000 animals were drowned; only 400 inhabitants survived. Of the present islands, one still called Nordstrand and another Pellworm, each about 10 kilometers across and both diked, together with a number of little undiked Halligs, are all that now remain of the ancestral island. A flood in 1825 was most severe on Hooge, a marsh-remnant Hallig outside of the original Nordstrand, at present about five kilometers across. The water there rose 14 feet above ordinary high tide; on four mounds the houses were all destroyed, and three inches of silt were spread over the marsh. This rapidly wasting island had 16 mounds with 153 families in 1758, but only 9 mounds with 41 families in 1894. Repeated losses of lives and property by overwhelming storms have been so disastrous that the abandonment of the islands has been proposed by non-residents; but the Hallig survivors hold their ground. On the whole it has been found wiser to preserve the islands by protective works around their shores, in part because the population furnishes many sailors to the navy and the merchant marine.

Pictures of Island Life

Those who wish to learn more of the Halligs than is told in Traeger's geographical description and Müller's monograph will find the homely ways of the Frisian islanders set forth in an overpious and rather too melancholy novel, "Die Hallig," by Johann Christoph Biernatzki (Leipzig, 1881), who as pastor of one of the islands nearly 100 years ago had intimate personal knowledge of them; his story closes with a vivid account of the storm flood of 1825. From an altogether different and quite unexpected source comes a most interesting account of a Hallig peasant family. The eminent and gentle-minded philosopher, Friedrich Paulsen, recalls in his autobiography, "Aus meinem Leben" (Diederichs, Jena, 1909), stories that he, as a boy in his home on the mainland marsh, heard about his forbears and their early life on the small Hallig, Oland, in particular that great event, the storm flood of February, 1825, when the fatal combination of wind and tide occurred.

Surely, no more striking example than that of the Frisian marshes, and of the Halligs in particular, can be found in which a remarkably uniform land of apparently unfavorable character has been persistently occupied by a simple folk under nearly constant conditions century after century, so that it has become to them the center, the home, with respect to which all the rest of the world is only a periphery.

THE EFFECT OF GLACIATION ON PROSPECTING FOR MINERAL DEPOSITS IN THE LAURENTIAN PLATEAU *

By T. L. Tanton
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The evidence of Pleistocene glaciation is one of the outstanding features in the Pre-Cambrian shield—a region noted for its mineral wealth—and an attempt is here made to present a concise, general statement indicating what the net result of glaciation has been as it affects prospecting in that region.

The method used is to consider various glacial phenomena in relation to the mineral occurrences of the region, to infer what the condition would be if there had been no glaciation, and to judge from field experience whether the effect to prospectors was beneficial or otherwise in the three physiographic divisions which are recognized within the Pre-Cambrian shield.

The ease with which mineral deposits are now found depends on the following conditions.

1. *Visibility of deposit.*—This condition involves (A) outcrop of deposit, (B) accessibility to an observer.

A. The factors which are to be weighed under this head are as follows:

The factor in glaciated area	*The factor in unglaciated area*	*Result to prospecting in the Pre-Cambrian shield*
(*a*) The deposition of ground moraine, original and reworked	Residual soil; transported deposits, viz., stream and lake deposits, hillside wash, beach deposits, marl deposits	Result considered by districts (map)
(*b*) Scouring of the rocks to an unweathered surface	No equivalent degree of visibility could be expected in unglaciated region	Result considered by districts (map)
(*c*) Disorganization of drainage system resulting in very numerous lakes which for this particular region greatly assists human accessibility	Present degree of inaccessibility of the plateau is due to lack of roads which would have been built had there been a suitable soil and climate to induce agricultural settlement. Since present climate is a controlling factor there is really no equivalent off-setting factor to be considered here	Nil in clay belt, elsewhere favorable

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* Published with the permission of the Director of the Geological Survey of Canada.

2. *Clues to position of deposit which are not directly observable.*—The factors which are to be weighed under this head are:

The factor in glaciated area	*The factor in unglaciated area*	*Result to prospecting in glaciated area*
(*a*) Transported fragments from mineral deposit aligned in the drift in the direction of glacial advance	Transported fragments from mineral deposits follow irregular courses controlled by gravity and local drainage system	Compensate
(*b*) Heterogeneous drift	Productions of easily recognizable gossan over ferruginous deposits	Unfavorable
(*c*) Irregularities in thickness of drift not deducible by glacial geologists	Thickness of cover over magnetic deposits might be deduced with more certainty, thus allowing of more important results from magnetometric survey	Unfavorable
(*d*) Physiographic features alter in such a way as to render the recognition of significant rock structures difficult	Drainage features may conform to significant structural features, e.g. faults	Unfavorable
(*e*) Topographic irregularities intensified where depth of easily transported material was not uniform thus bringing into prominence shattered fault zones bounded by hard, dense rocks		Favorable

THE CLAY BELT

The "clay belt" is an area of considerable size which in the Pre-Cambrian shield borders the Paleozoic rocks in the James Bay district. There are a number of comparatively small, irregular areas which have similar characteristics, but only the larger areas are indicated on the map. In these areas the bed rock is presumed to be of the same character as in the typical shield; but outcrops constitute less than one per cent of the area, and there is a deep mantle of till (largely Paleozoic débris) and post-glacial lacustrine clay deposits. There are comparatively few lakes in the clay belt.

The extent to which the bed rock would have been concealed by fluviatile, lacustrine, and other loose deposits in the same area had it not been glaciated is a matter for speculation. A full discussion of the matter would involve so many purely theoretical considerations that the result would have little significance. It is manifest that in this area we find, developed in the highest degree, the obscuring of the bed rock by a heterogeneous mixture, largely of foreign débris, which gives no indication of the nature of the material beneath. It is a safe generalization that the net result of glaciation, in so far as the clay belt is concerned, has been unfavorable for prospecting.

Upper Pre-Cambrian Areas

In the areas underlain by Upper Pre-Cambrian rocks the gently inclined sediments and great sills of diabase have been faulted and dissected by erosion; the local relief is high, the soil cover is thin, and lakes are numerous. The scouring of the rocks, the removal of old talus accumulations, and the cleaning out of loose materials in zones of structural weakness transcend in importance the glaciation effects which are undesirable from a prospector's standpoint. The minerals sought for are in veins which frequently occupy faults. The general effect of glaciation has been decidedly beneficial for prospecting.

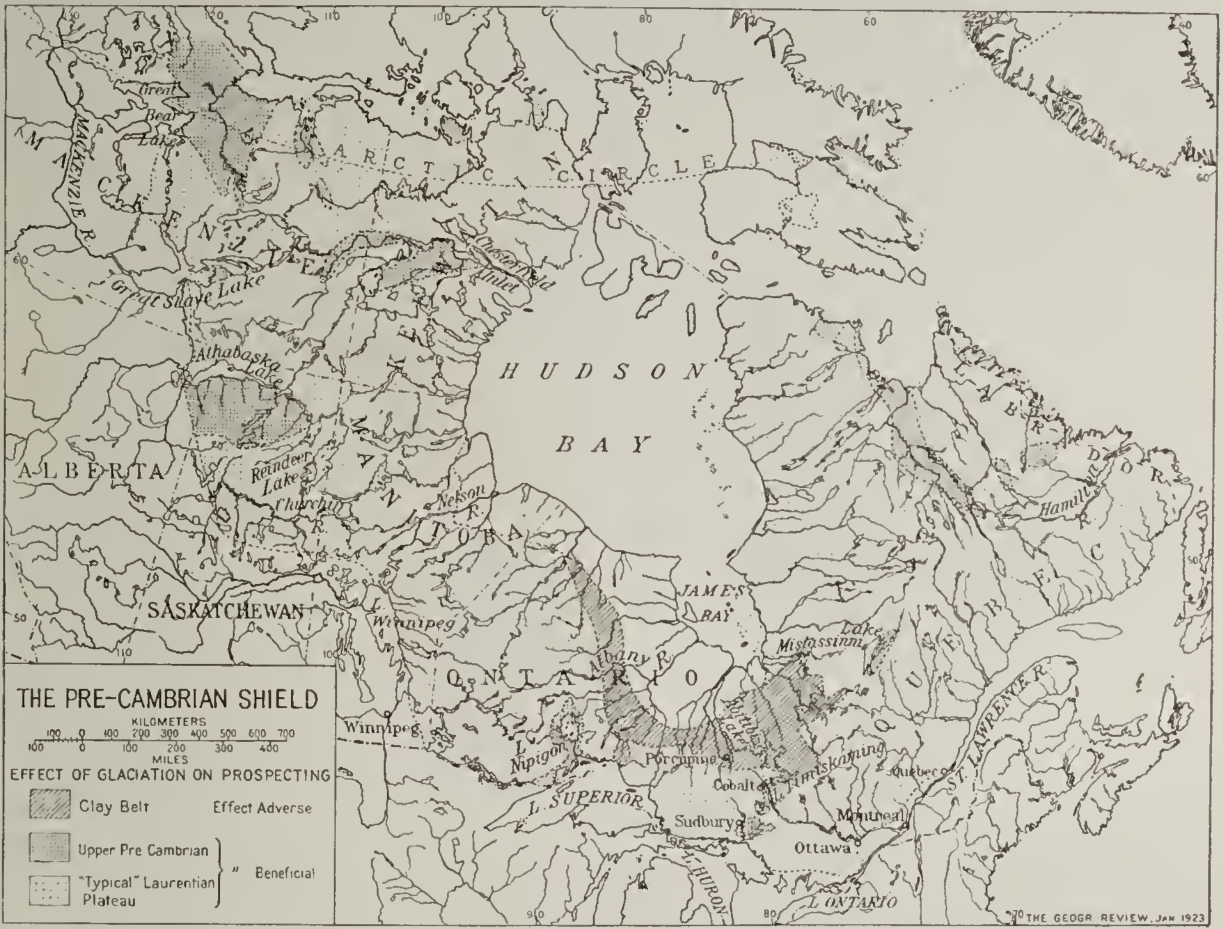

FIG. 1—Map to illustrate the effect of glaciation on prospecting for minerals in the Laurentian Plateau. Scale of map approximately 1:35,000,000.

Typical Laurentian Plateau

The typical Laurentian plateau is characterized by mammilated, rocky hills and ridges of low relief, an irregular but generally thin mantle of till, and a disorganized drainage system made up of abundant lakes and interrupted spillway rivers. A statement of the various effects of glaciation makes it clear that the prospector for all types of deposits has been favored in some measure and obstructed to some extent; and, so far as the actually coming upon the deposit is concerned for one traversing the ground, there is an almost complete compensation from the glaciation-effect factors.

While traversing certain Keewatin areas remote from frequented routes of travel, the writer has stripped moss from veins which would warrant the expenditure of time for examination by a prospector. He has felt that the means which rendered the district as accessible as it is, i.e. the numerous lakes due to disorganized drainage resulting from glaciation, is to be regarded as a material benefit to the prospector.

Some light on the question may be gained by considering the conditions under which successful prospecting has been carried on in northern Ontario and speculating as to the probable difference had the district been unglaciated.

The Sudbury copper-nickel ores were found in outcrops. Rock outcrops are sufficiently numerous to permit of areal geological mapping. With the geological map and the information gained in early development work Dr. Coleman was able to state a theory of genesis and to deduce that a certain more or less oval zone would be the site in which ores might be expected to occur. An attempt to locate ore in a drift-covered part of the zone has met with success. Intensive prospecting through the drift is not now carried on because the ores so found are not commercially recoverable in competition with outcrop ores. Had the district been unglaciated, the factors relating to human travel remaining the same, it is probable that prospecting would have been easier on account of the existence of a pronounced gossan of limonite and the green secondary minerals of copper and nickel.

In the Cobalt district the first discovery was made by the chance encounter of silver by a workman engaged in constructing the Temiscaming and Northern Ontario Railway. Such a number of fortuitous circumstances led to this first discovery that the question of glaciation or non-glaciation is here insignificant. Following the first discovery there was a rush, and a sufficient number of rich veins were discovered to establish an important mining camp. The factors which were mainly responsible for success were—the bareness of the rock, the accessibility of the trackless forest by means of canoe routes, and the existence of a geological map which was sufficiently accurate along canoe routes to enable prospectors to concentrate their attention on these rocks which the theory of ore genesis indicated as most promising. Had the district been unglaciated, prospecting would have been very much more difficult since the narrow calcite veins would probably occur in depressions and be covered with slumped soils or transported products of rock weathering.

In the Porcupine district outcrops of gold-bearing quartz veins were discovered long before the famous discoveries which caused the rush in 1909. During and after the rush a great many gold-bearing quartz veins were found in outcrops. The greater part of the mineralized area is covered with the deposits which characterize the clay belt. The earliest reported discovery and also the one which caused the rush were made in consequence of the veins lying in plain sight from a portage trail on a canoe route between Mattagami River and Nighthawk Lake.

Had the district been unglaciated, would the gold-bearing quartz veins have stood up as more prominent ridges? Would the loose surface deposits have masked more of the important veins or less? Is not the beneficial scouring effect of glaciation largely offset by the general smoothing of the country which makes possible a masking of a large area by a comparatively thin lacustrine deposit? There is ground for argument on all these questions. In the writer's opinion more gold-bearing quartz veins would have been exposed than is now the case, but the chances of discovery, away from any water route, would have been less.

ARGENTINE PHYSIOGRAPHICAL STUDIES: A REVIEW*

By Alan G. Ogilvie

Modern investigations of land forms in South America are very few, and it is a pleasure to be able to review the results of five which have appeared in the last two years. All of them deal with the sierras and cordilleras of Argentina; four are short papers, and one an important monograph. The paper by Sobral deals with parts of the area treated in the monograph by Penck and will be discussed after the latter. The regions studied, then, are four: the southeastern border of the Puna de Atacama with the Sierra and Bolsón de Fiambalá to the east of it, northern Neuquén near the Chilean boundary, the Sierra de Tucumán, and the Sierra Grande de Córdoba. All of the authors are geologists, and, while their physiographic researches necessarily and properly in most cases have been closely bound up with other geological work, their results might have been more generally useful—to geologists as well as to geographers—if they had included in their presentation more graphic accounts of the landscape.

Southern Edge of the Puna de Atacama and the Sierra and Bolsón de Fiambalá

Walther Penck in his geological study of the southern edge of the Puna de Atacama has furnished "a contribution to knowledge of the Andean mountain type and to the question of mountain formation"—to quote the subtitle of his work. This voluminous treatise of 420 pages with eight plates of photographs, one of geological sections, and a geological map, represents the results of two periods of close and industrious field work carried out in 1912 and 1914 on behalf of the Dirección de Minas of the Argentine government. There are few such thorough regional studies in the geological literature of South America, and certainly Penck is the first to investigate in such detail the structural and surface features of one of the important and characteristic tectonic basins of the eastern Andes. To have this intimate and admirable portrait of a typical *bolsón* and its surrounding mountains is to go a long way toward understanding the physiognomy of a hundred others; and this is a necessary preliminary to the appreciation of Andean geography. The area studied was first surveyed topographically by the author; and the result, an excellent map on the scale 1: 200,000 with contours at 100-meter intervals, was published in 1918.[1]

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* Walther Penck: Der Südrand der Puna de Atacama (NW-Argentinien). Ein Beitrag zur Kenntniss des Andinen Gebirgstypus und zu der Frage der Gebirgsbildung. vi and 420 pp.; map, diagrs., ills., bibliogr. *Abhandl. Math.-Phys. Klasse der Sächs. Akad. der Wiss.*, Vol. 37, No. 1. B. G. Teubner, Leipzig, 1920.

José M. Sobral: Some Physiographic Notes on the Sierra de Famatima. Map, ills. *Geografiska Annaler*, Vol. 3, 1921, pp. 311–326. Stockholm.

Pablo Groeber: Mutación del divortium aquarum del norte del Neuquen en el Plioceno superior. Map, diagrs. *Bol. Direcc. Gen. de Minas, Geol. e Hidrol.*, *No. 1*, *Ser. F.* (*Informes Preliminares y Comunicaciones*) pp. 1–17. Buenos Aires, 1920.

Franz Kühn: Notas sobre la orografía de Tucumán. 2 panoramas. *Fenix*, Vol. 1, 1921, pp. 48–52. Buenos Aires.

Oscar Schmieder: Apuntes geomorfológicos de la Sierra Grande de Córdoba. Map, diagrs., ills. *Bol. Acad. Nacl. de Ciencias en Córdoba* (*República Argentina*), Vol. 25, 1921, pp. 183–204.

The Puna de Atacama is the southern part of the Puna region which occupies the major portion of the Central Andes. We now have presented to us in an accurate and definitive manner the important transitional area in which these high broken plateaus of interior drainage meet the lower and more habitable region of the sierras and valleys drained by the La Plata system. The area studied lies mostly between 27° and 28° S. and between 67° and 69° W. Its western half and northern fringe are regarded by the author as belonging to the Puna. Its eastern half includes the Sierra de Fiambalá with the Cerro Fraile; and between these and the Sierra de Famatina, which is the Puna rim, lies the depression, or *bolsón*, of Fiambalá.

No attempt will be made here to review the volume as a whole, the place for such a review being a geological journal. But, before passing to a discussion of the aspects more directly affecting the geography of the region, it may be useful to say something of the content of the work. In the opening chapter various geographical questions are briefly dealt with—position, orography, climate, hydrography, landscapes, and settlements. Two long chapters (137 pp.) follow, in which the rocks, igneous and sedimentary, are described and their geological significance is treated; and these are followed by two other chapters (106 pp.) dealing with geological history and tectonics. It may be noted that the broad aspects of the building of the Andes receive thorough treatment in this section. The work is concluded with a discussion of the surface evolution of the Puna rim. The longer, meridional axis of the *bolsón* marks the division between mountains, on the one hand, which belong structurally to the pampean sierras and, like the Sierra de Córdoba referred to above, are composed mainly of ancient crystalline rocks and, on the other hand, the ranges of the Puna rim on the west, which belong to the pre-Cordilleras and include folded sedimentary rocks (Paleozoic) in their composition. Perched high on the greatly denuded surface of the Puna, which extends westward to the Western Cordillera and the Chilean boundary, there are several isolated groups of volcanoes. The parallel mountain ranges which form the southern fringe of the high plateau may be considered, broadly speaking, as finger-like remnants of the highland now separated by structural hollows—the *bolsóns* and *valles* of northwestern Argentina. While the more obvious surface features, the contrast of high, smooth Puna with its volcanoes with the rugged fretted eastern rim, are due in the main to a geological history including long periods of emergence and denudation followed by large tectonic disturbances, the land forms derive their character in detail from peculiarities and contrasts of the climate of the present and recent past, as well as—especially on and below the Puna rim—from variation in rock type.

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[1] Walther Penck: Topographische Aufnahmen am Südrand der Puna de Atacama (NW. Argentinien), *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1918, pp. 193–212.

Penck describes the existing climate in some detail and furnishes explanations of its features. The contrast is pronounced between the fringing hollows on the one hand and the high sierras and Puna on the other. The prevalence of a more or less permanent area of low pressure on the low Chaco to the east of the Andes occasions a very regular and strong daytime wind on the Puna; and this is cold and dry, the only precipitation in this region being the snow brought to the high volcanoes from the southwest, by occasional moving depressions. This westerly current does not become a down-valley *föhn* wind on the eastern slope of the mountains but appears to maintain its level, and so must enter the low pressure area gradually. When the Chaco "low" retreats, a biting north wind (*zonda*) supervenes on the Puna. In his discussion of the plateau winds the author's use of the term "anti-trades" seems to be misleading. From its association with references to altitude and latitude (pp. 31 and 254) it is not perfectly clear to the reviewer whether he is using the term correctly to denote the upper return currents of the trade wind zone or applying it incorrectly to the westerlies of lower latitudes.

The intense daily heating of the Bolsón de Fiambalá induces a regular south wind which springs up in the south and spreads northward throughout the forenoon. By early afternoon it ascends the northern rim of the Bolsón and becomes cooler, but as a rule it does not pass an altitude of 4000 meters. This wind carries much sand and builds it into large dunes, which are a constant menace to the farmers of the valley. These winds are not followed by north winds at night, and the author believes that this daily access of air to the Puna level finds compensation in the prevailing westerlies there. The most important wind from the economic as well as the physiographic standpoint is the easterly wind of summer; for with it comes the only rain of the Puna rim, mostly in the form of thunderstorms. But even in summer precipitation is the exception in the Bolsón; commonly cloud only is formed. In summer the high sierras become "islands" in an intensely dry region which are relatively moist on their eastern sides. Thus watersheds have been pushed westward; springs, streams, and alluvial fans are on the eastern side, and here also are the sparse settlements. The Sierra de Fiambalá is higher in the north (over 5000 meters) and consequently receives more rain there and is more thoroughly dissected.

The hydrographic results of such a combination of relief and climate may be briefly stated. The only perennial streams are, paradoxically, the antecedent rivers which come from the Puna (Río de la Troja, Río Chascuil), receiving their entire water not from the plateau itself but from the melting snows of the isolated volcanoes. The summer streams, which are most intermittent, being occasionally in high flood, at other times generally dry, are mostly on the eastern slopes of the sierras. The detritus of the highlands, then, so far as it is water-borne, reaches the Bolsón from the west, and the great alluvial fans have pushed right across the depression. Thus the settlements, which are entirely agricultural—Tinogasta, Puesto, Fiambalá, and Medanito—are near the eastern edge of the Bolsón. The first three of these, named from south to north, receive water from the Puna rivers, while Medanito is entirely dependent on the Bolsón water tables emerging at successive levels in the meridional channel known as the Río Abaucan. These agricultural towns subsist by the irrigation of the fertile sandy loess which covers the eastern part of the Bolsón, and they produce by irrigation heavy crops of wheat, maize, alfalfa, oats, grapes, figs, oranges, pomegranates, olives, and other fruits. Palms do not grow, although they flourish in the Bolsón de Andalgalá of similar latitude and altitude. The remainder of the sparse population lives in scattered farms on the alluvial fans to the west mostly below 2500 meters. In winter the Puna and sierras are unpopulated, but in summer flocks are pastured at high altitudes. The four towns show signs of decay owing to the decreased importance of two ancient trade routes which converge here, coming respectively from the Copiapó region of Chile and from Bolivia by way of Antofagasta de la Sierra.

Penck has made a very systematic study of the processes of denudation in this arid climate; and he brings out his conclusions in systematic form, showing the divergences from the laws which apply in moist climates. While these conclusions for the most part are not new, it is exceedingly valuable to have this detailed investigation from South America. Morphologically the region falls into well defined zones. On the Puna mechanical disintegration is by far the most potent agent. Every surface of bare rock is rapidly broken up by the sharp temperature changes, and the whole region is being rapidly leveled and is tending towards an undulating surface covered by a thick mantle of rock fragments of all shapes and sizes. Transportation downwards, of course, takes place under the influence of gravity. It is shown that movement is initiated in the following manner. At a given moment the angle of slope is such as to maintain stationary the mantle of a given mixture of fragments, large and small. But the fragments are continually being reduced in size, and adjustment of slope to suit changing mixtures destroys equilibrium. This constant adjustment maintains a downward motion. Thus the number of large blocks is found to diminish downhill, and, since the rate of motion increases with the proportion of small particles and so becomes more and more rapid, these latter are to be regarded in some sense as a medium of flow comparable to water. In such a manner large areas may be leveled without reference to any base level outside the area.

On the Puna rim the rock mantle makes its way to marginal valleys and is held even to widen and deepen these by abrasion. In the valleys the base level of such erosion and transportation is the alluvial fan, which of course is itself the product of the summer floods (*crecientes*). Such features and processes characterize the Puna and its rim above about 3800 meters. Down to this level accumulation has predominated for a long period. The cold, arid climate of the Pleistocene in this region favored accumulation quite as well as does the warmer aridity of the present, and it prevailed to a level from 600 to 800 meters lower than does the present similar condition. Thus the author explains a zone below 3800 meters marked by deeply dissected Pleistocene deposits—the second of his marginal terraces of the Bolsón, the highest of which is regarded as of Pliocene age. These terraces are held to mark stages in the differential movements which have produced the Bolsón. Reduced to simplest terms, then, the Bolsón rim consists of smooth upper slopes with a thick mantle of fine rock fragments, deeply dissected lower slopes marked by successive terraces in valleys and on interfluves, and great alluvial fans rising to 400 meters and varying in slope and extent according to the nature of the rock from which their materials are derived. Study of the longitudinal profile of the Río Abaucan, which is the main artery of the Bolsón, reveals some interesting features. In such virtually enclosed and arid depressions a general base level of erosion plays no part, as it would were there a regular drainage to the sea. Instead we find a series of water tables in the body of the alluvial fans, and each of these forms the base level of erosion for successive stretches of the Río Abaucan. This operates in such manner that the river alternately flows in a shallow channel and in canyons, the canyons corresponding to the reaches where the bed is on one or other of the water tables.

This monograph will be valuable to every student of the geography of arid regions and of the critical and fluctuating zone in which slight increases and decreases of moisture may have far-reaching results. It would seem that such a monograph might with advantage have contained a brief summary of conclusions, furnished with references to pages. In the absence of an index or at least a summary with references it is difficult to use a book of such length as the work of reference which it ought to become.

Sierra de Famatina

The paper of José M. Sobral loses much of its value from the fact that most of its elements are treated more systematically by Penck, who covered the northern portion of the Sierra de Famatina in his investigation, while that of Sobral deals with the southern part. He starts by contesting the statement, contained in a paper by Franz Kühn[2] (not yet received by the reviewer), that the higher parts of the Sierra de Famatina are remnants of an elevated peneplane. With this the author does not agree, believing that all traces of the old surface have been removed by denudation. He points out that, while he has observed in the highest ridges of the Sierra numerous amphitheaters which are undoubtedly the remnants of glacial cirques (also observed farther north by Penck), nevertheless all the lesser evidences of glaciation have been removed. Now he thinks there is little doubt that this range, reaching to over 6000 meters in altitude, was heavily glaciated in the Ice Age, and he believes that if the glacial surface has been destroyed to such a great extent it is unreasonable to look for remnants of a preglacial peneplane. Penck, however, demonstrates that the range was not heavily glaciated. There are cirques with terminal moraines down to 5200 meters, but no evidence of valley glaciers. Moreover, he describes extensive Pliocene surfaces as existing today. Like Penck, the author has been greatly impressed with the thick and widely spread mantle, or "slide rock," of angular fragments disintegrated by atmospheric agencies and moving under the influence of gravity. He describes carefully the conglomerates composed of angular fragments cemented with limonite at altitudes varying between 2500 and 4500 meters. This the author, in agreement with Penck, takes as evidence that the same processes of denudation which he notes as characteristic today have long been going on. The conglomerate is held to be of postglacial or perhaps of interglacial age, and the author notes especially its existence in the valley of the Río Amarillo at 2500 meters, pointing out that at the time of its formation there can have been no stream at that altitude capable of clearing its valley and, further, that the climate which presumably favored the cementation by limonite—short periods of heavy rain followed by dry sunny periods—is not now characteristic. But it is nearly matched today in the much higher valley of La Mejicana at about 4600 meters.

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[2] Franz Kühn: Observaciones morfológicas en la región central de la Sierra de Famatina, *Anal. Museo Nacl. de Hist. Nat. de Buenos Aires*, Vol. 30, 1920.

In a note the author refers to the occurrence of *nieve penitente*, the jagged surface of snow fields produced so characteristically in the strong sunshine of the Southern Andes and about which there is a considerable literature to which this footnote is a preliminary contribution. He throws out a suggestion which may have more than merely local application. He believes that the initial cause of the feature is the differential movement of the rock slides underlying the snow. This causes a crevassing of the surface so that in the troughs the slide rock may be seen. Further snow falls both on ridges and troughs; but subsequent wind deposits more dust in the troughs than on the ridges, and the heat absorbed by the dust melts the snow in the troughs more rapidly and so accentuates the ridges and pinnacles.

NORTHERN NEUQUÉN

During the earlier part of the Pliocene period the most northerly part of Neuquén was drained to the Pacific, and much of the relief of that time was subsequently buried by thick volcanic deposits. The proof of this fact forms the main subject of the paper by Dr. Pablo Groeber, the result of investigations made in the spring of 1919.

Four diagrammatic cross sections are drawn to illustrate stages in the morphologic evolution of the region. In phase one, a peneplane of early Tertiary age cut upon tilted porphyrites and Jurassic and Cretaceous sediments is seen to be covered by a thick andesite sheet lying nearly horizontally. In the second phase, this is thrown into a broad anticline of which the axis coincides with the Cordillera del Viento immediately east of the present upper Neuquén River. At the end of the third phase partial planation has again been attained, the andesites having been denuded from the higher parts of the anticline; and, lastly, after further uplift the planed surface is shown as deeply dissected. This last diagram represents the region in the earlier part of the Pliocene and prior to the burial of the surface under the basaltic sheets which greatly modified its aspect. But this burial itself antedated the last great uplift of this part of the Andes, which took place from later Pliocene to Pleistocene times. The author has studied in some detail the relief (early Pliocene) which existed prior to the spread of the basalt, and he comes to the conclusion that a leading feature in it was a deep longitudinal valley occupying the axis of the anticline above referred to and drained northwards from near the present Cerro Domuyo by an ancestor of the existing Río Maule. From near the same peak another river, an ancestor of the Río Ñuble, ran westward across the present head valleys of the Neuquén. Thus the region was drained to the Pacific Ocean. All this was changed by the infilling of the valleys by volcanic materials, and the present aspect of the landscape depends mainly upon this and upon the subsequent dissection of the basalt owing to great uplift of the whole system. The effect of rejuvenation in the rivers is much less marked in the basin of the Río Varvar-Co than in that of the Río Barrancas on the eastern edge of the area, since the former flows into the Río Neuquén and is much more distant from the foot of the Cordillera.

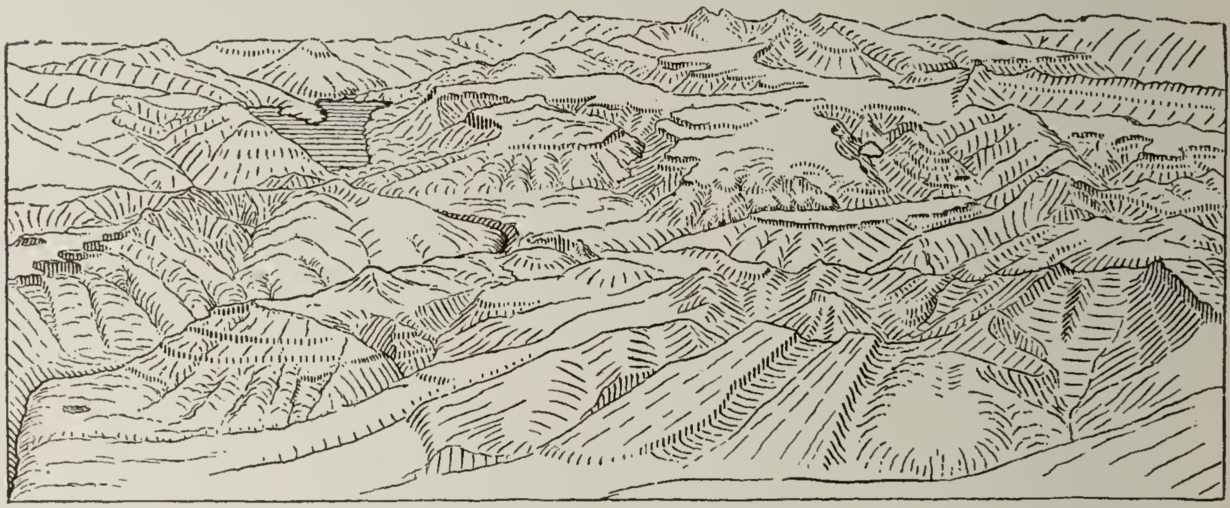

FIG. 1—Diagrammatic sketch of part of Neuquén immediately north of the Cordillera del Viento, viewed from the south, slightly simplified from the diagram by Pablo Groeber. The left (western) half is occupied by the basin of the Río Varvar-Co with Lake Varvar-Co-Campos draining to the Río Neuquén. The valleys of the right background drain to the Río Barrancas. The Cerro Domuyo is in the right foreground.

The paper contains no summary or sketch to show clearly which parts of the present relief are to be referred to the various phases; but from the "imaginary panoramic view from 10,000 meters" and the map on which "pre-basaltic" contours and drainage have been drawn it would appear that only very small parts of the present surface can be referred to the earlier phases. The panorama would have been more useful physiographically had it been converted into a block to show the geological sections on two of its edges.

The main features of the existing landscape (see Fig. 1) appear to be:

1. A line of serrated ridges forming the summits of the Cordillera del Domuyo extending from north to south and separating the drainage basins of the Barrancas on the east and the Varvar-Co on the west. These ridges seem to be fretted by the Pleistocene glaciers.
2. The extensive undulating surfaces of basaltic accumulations trenched in places by rather shallow glacial valleys.
3. Numerous steep-sided valleys deeply dissecting this surface, their upper edges often marked by precipices corresponding to basalt flows, and the valley bottoms here and there occupied by lakes such as the Lago Varvar-Co-Campos.

OROGRAPHY OF TUCUMÁN

Sierra de Tucumán is the name given to the eastern slope of the Sierra del Aconquija and its northern extensions. The hydrographic system is typical; wide longitudinal valleys, lying approximately north and south (tectonic basins), and narrow transverse *quebradas*, due to progressive erosion. Thus the mountains are divided into isolated blocks.

The brief paper of Dr. Kühn, which is virtually an explanation of two panoramas, is not as helpful as it might have been to a reader who desires to receive a general impression of the land forms and their origin. Panorama I, looking west from a tower in the city of Tucumán includes a section of the mountains some 110 kilometers in length. The horizon consists of a line of summits varying in altitude from 4200 to 4500 meters and taken to represent portions of an elevated peneplane of pre-Tertiary age. In this panorama the accordance of level in the summits forming the horizon is well brought out. These summits are described as remnants of an elevated peneplane broken—presumably by subsidence—in the longitudinal valleys, which are referred to as tectonic basins, and dissected by erosion in the transverse valleys.

Panorama II, in which the view is eastward, shows a smaller stretch of country mostly hidden by nearer hills in Panorama I. The hills seen in this are assigned to a "pre-Tertiary peneplane" whose relationship to the higher surface mentioned above is not disclosed; but a higher peak is described as a "monadnock," and it would seem that this may represent an isolated portion of the higher erosion surface.

SIERRA GRANDE DE CÓRDOBA

The plateaus and ridges which are thus named lie to the west of Córdoba, extending from north to south for some 400 kilometers with a breadth of 100 kilometers at the widest part. Of all the pampean sierras this is the one most widely separated from the Andes. Oscar Schmieder has made a preliminary physiographical study of the section lying to the southwest of Córdoba—about 3000 square miles in area.

The crystalline and Paleozoic rocks of these plateaus have been regarded as an isolated block of the Brazilian shield. In the part discussed granites appear to occupy the chief place. The author's conclusions regarding the genesis of the plateaus may be briefly stated. The Sierra here consists mainly of broken remnants of a pre-Tertiary peneplane with their longer axes north and south and both tilted to the east. Between the blocks is the *bolsón*, or structural basin, of Nono, which is drained to the southwestward by a river incised in the southern extremity of the more westerly block. The northern edge of this block abuts on the recent volcanic mountains of Salsacate. The more easterly block is flanked on the east by a cuesta known as Sierra Chica, continuous save for the gaps through which the higher Sierra is drained eastwards. The chief complication occurs in the more easterly block. A forty-mile section of the upper western part of this tilted plateau has been thrust up to a still greater elevation, thus forming a horst. The relationships of these features can be seen in the diagram (Fig. 2) generalized from the author's map and section.

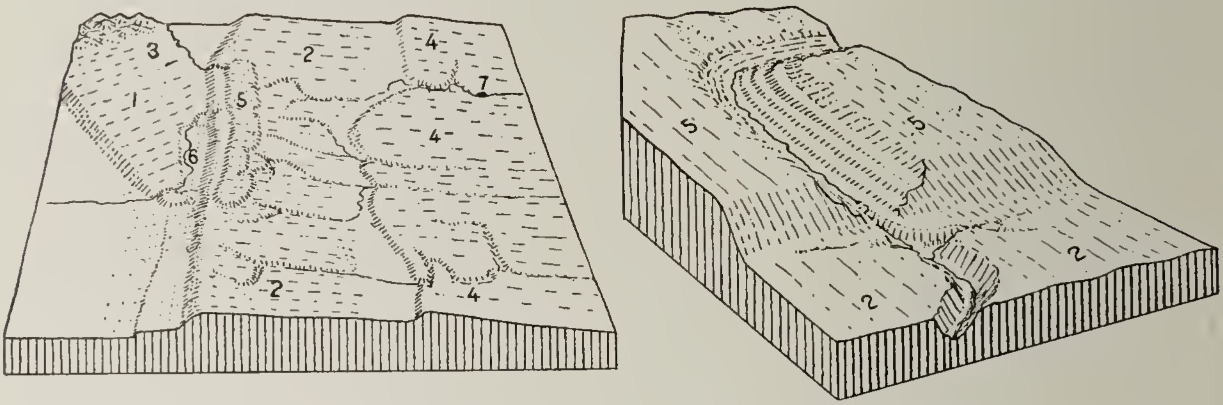

FIG. 2—Block diagrams drawn from data in the paper by Oscar Schmieder.

a (left). The region viewed from the south: 1, western tilted block(Pampa de Pocho); 2, eastern tilted block; 3, volcanic mountains of Salsacate; 4, Sierra Chica; 5, the horst (Pampa de Achala); 6, the *bolsón* of Nono; 7, Córdoba.

b (right). Portion of the blocks 2 and 5 viewed from the southeast, illustrating the relationship of the valley terraces to the fault scarp.

The peneplane surface appears to be best preserved on the highest block, the Pampa de Achala. Here there are many shallow valleys of small gradient and numerous low residual hills often consisting of resistant parts of the granite. Rejuvenation of the valleys due to the last positive movement which has resulted in the deep dissection of the eastern block has so far only notched the edge of the horst. The most detailed part of the author's work has evidently been devoted to this plateau, and he has revealed the existence of interesting terraces of erosion in its valley. These are taken to mark the successive stages of uplift of the block. They are three in number, and all of them are "hanging" terraces in the sense that they end "in the air" on the eastern scarp of the block (see the diagram, Fig. 2, which has been drawn with the help of the sections and photographs contained in the paper). The highest terrace lies generally parallel to the tilted surface of the horst, while the two lower—parallel to each other—make a considerable angle with the highest. The author, taking the terraces to mark successive uplifts of the horst, concludes that this section of the peneplane with its old valleys was first tilted eastwards and then, after being dissected down to the highest terrace, was subjected to two vertical thrusts by which the eastern scarp was formed and later increased in height. The two lower terraces mark the stage of dissection reached prior to these positive movements. The present bottom of such valleys corresponds to the upper surface (the peneplane) of the eastern block.

All of the works reviewed make some reference to one or more surfaces of erosion, some of them actually existing, others revealed as buried or deformed peneplanes. This fact encourages the hope that such observations by other geologists in other parts of the Andes will quickly accumulate and that the date is not far distant at which evidence already collected—such as that from the Central Andes—can be correlated with the new results. We can then look forward to a much simplified, comprehensive picture of Andean relief, to be used as a basis for understanding irregularities which fundamentally are of minor importance.

GEOGRAPHICAL ELEMENTS IN THE TURKISH SITUATION: A NOTE ON THE POLITICAL MAP

The Treaty of Sèvres, signed but never ratified, has finally become a dead letter with the consequence that the revised political maps of the past two years must undergo another revision. The treaties between the Allied and Associated Powers and the Central Powers have been ratified, and their territorial clauses have gone into effect with minor modifications.[1] The different fate of the Treaty of Sèvres is not surprising. It was apparent early in the war that the Turkish settlement would probably be the most difficult of all. The policy of the Ottoman Empire with reference to deportations, massacres, and conscription had brought about ethnic distributions calculated to make the setting up of government by minorities an almost impossible task even if the matters of territorial adjustment and boundary definition had not presented problems of the first magnitude. Treaty making was further complicated by the territorial provisions of the so-called Secret Treaties (London, Sykes-Picot, St. Jean de Maurienne, Sazanov-Paléologue) signed during the war by which nearly the whole of Turkish territory was divided into spheres of influence designed to be under the control of Great Britain, France, and Italy.

For an understanding of the developments that have led to the present situation it is helpful to turn to the geographical elements of the problem. On the one hand, we have the distribution of the chief material assets of the Turkish Empire—population, railways, ports, products; on the other, the less ponderable but no less vital questions of religion and prestige.

Religion and Prestige

The Turk has grown too well accustomed to modern life to miss the significance of trade in making religion a business. And there is no doubt at all that Mohammedanism is good business for the Turk. Most of the 270,000,000 Mohammedans in the world are so situated that they can make capital out of their religious kinship if they so desire. They form a sort of fraternity inhabiting an area of unrest wider and deeper than Europe itself and separating Europe from the tropical and subtropical lands of the Old World. In their arid or semiarid terrain they have an excellent natural defense. Their geographical situation places in their hands vast possibilities for making trouble. For the past one hundred years the Turk has given ample proof that he well knows the principle that not only power but also the balance of power matters, whether in business or politics. England could be relied on to solve the Mohammedan question of northern India if there were not millions of other Mohammedans beyond the Indian frontier. France is perpetually involved in the Mohammedan question, holding Morocco at one end of the Mediterranean and Syria at the other, a distance of more than 2000 miles.[2] Italy was giving a new orientation to her Mohammedan policy when she signed a treaty of peace with the head of the Senussi confraternity whose stronghold is desert Libya[3] and when she retired from Albania to please the Mohammedans there and thus keep the goodwill of the Mohammedan populations about the eastern end of the Mediterranean.

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[1] See the *Geogr. Rev.:* The New Boundaries of Germany According to the Peace Treaty, Vol. 7, 1919, pp. 281–290; The New Boundaries of Austria, Vol. 8, 1919, pp. 345–349; The New Boundaries of Bulgaria, Vol. 9, 1920, pp. 299–305; The New Boundaries of Hungary, Vol. 10, 1920, pp. 408–412.

The trade motive is likewise revealed in the Near Eastern policies of the three powers—France, Italy, and Great Britain. The war debts of these powers and the need for trade revival under exceptionally favorable circumstances have increased the competition for Levantine trade and economic privileges in the tributary lands. Given such a situation, the opportunity of the Turk, historically an exploiter himself long before the western powers learned the art, lies plain before him.

DISTRIBUTION OF POPULATION ACCORDING TO NUMBERS AND RELIGION

Something of the strength and weakness of the Turk in his former Empire is seen in the map (Fig. 1), showing the distribution of Mohammedans.[4] The dotted line marks the northern limit of the Arab peoples. It is in close accord with the modification of the Treaty of Sèvres line in the Angora agreement. The solid Turkish block of western Anatolia, the basis of a national Turkey, has its centers in Angora and Konia, typically interior towns. The chief ports and coast regions of densest population have a considerable non-Turk element, chiefly Greek.

The extent to which the Turkish Empire would have been reduced by the Treaty of Sèvres, had it been ratified and enforced, may be appreciated from the map (Fig. 2) no less than from the population figures of the eight principal towns left in Turkey.

Constantinople	1,000,000
Brusa	110,000
Kaisaria	54,000
Konia	45,000
Sivas (Sebasteia)	65,000
Bitlis	40,000
Trebizond	55,000
Diarbekr	38,000

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[2] Compare the article by E. F. Gautier, "Native Life in Northern Africa," and the note, "The Census of 1921 in French North Africa," in this number of the *Review*.

[3] Compare the note, "The Political Geography of Italian North Africa," in the *Geogr. Rev.*, Vol. 12, 1922, pp. 134–137.

[4] Both this map and that of population density are based on pre-war statistics, and in many places the actual conditions today depart widely from those shown. Nevertheless, such maps are of real value in that they show where population established itself under stable conditions and where it is likely to resume its usual activities, for the immutable facts of relief and climate and geographical position will recall into being much the same centers of production; and racial activities, while subjected to far more varied and complex controls, tend to revert to the old channels.

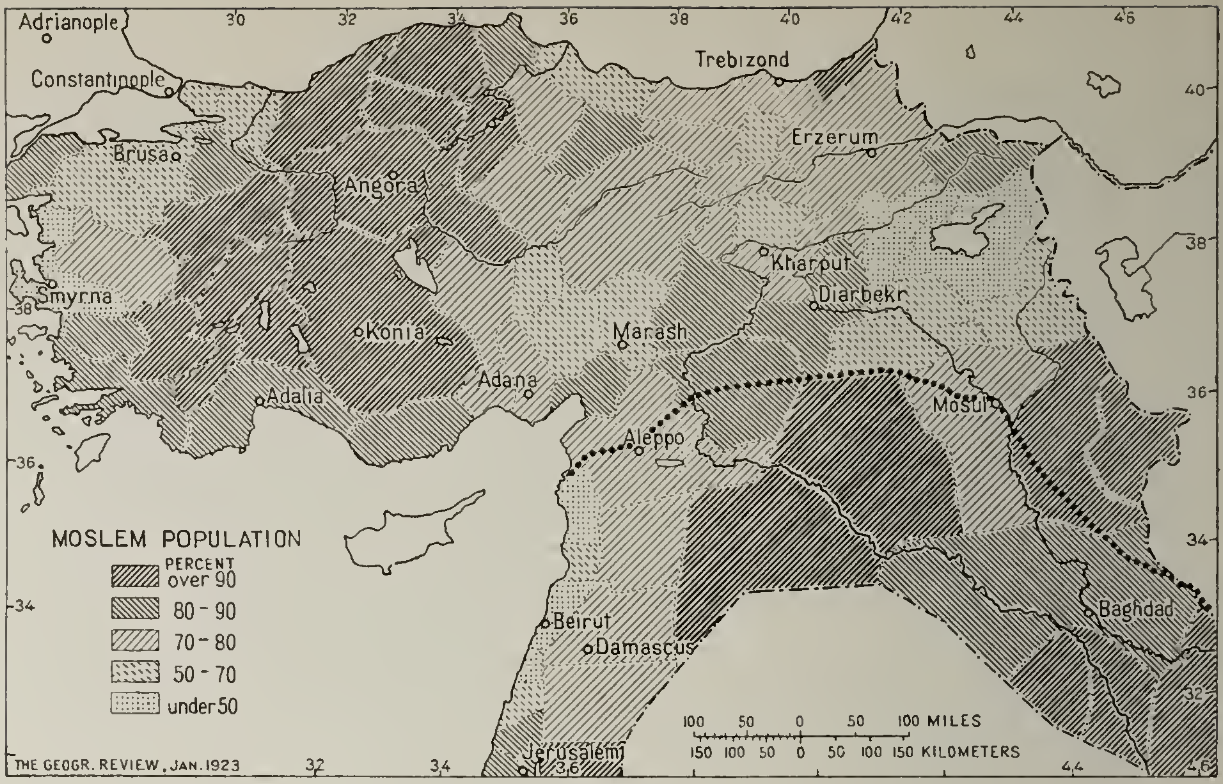

Fig. 1

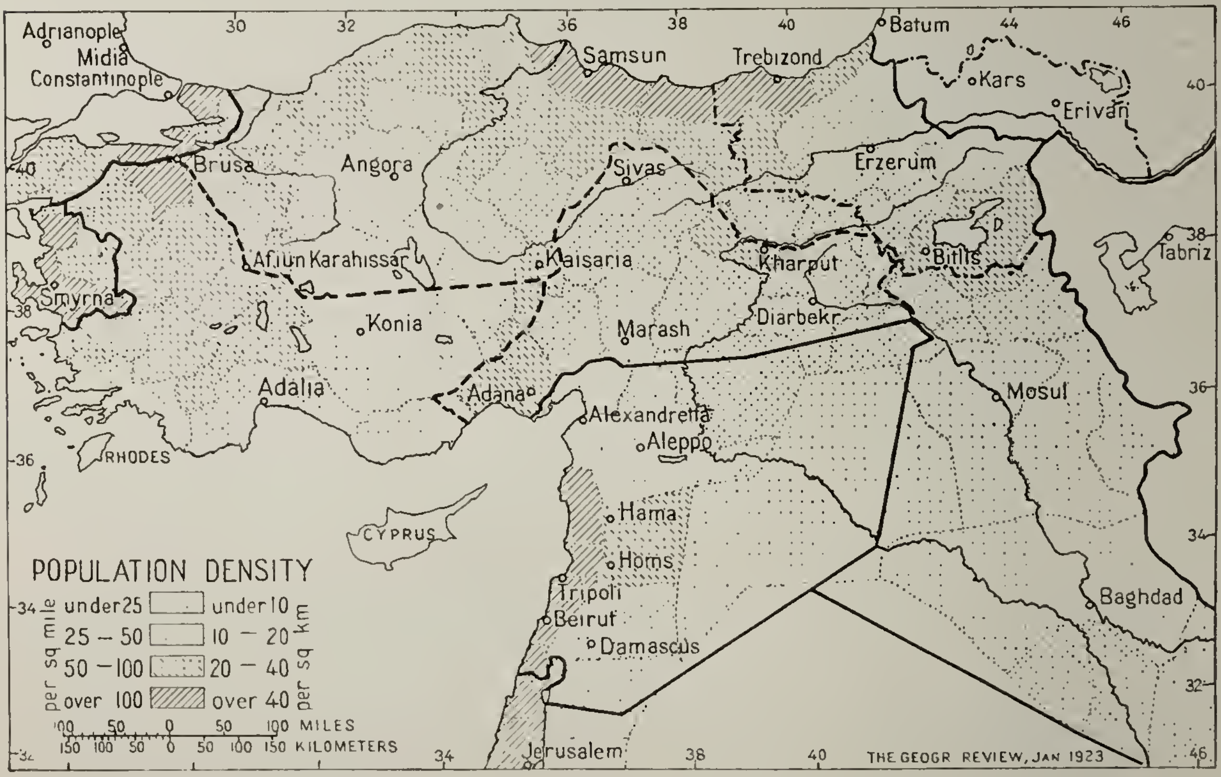

Fig. 2

Fig. 1—Percentage of Moslem population in Asiatic Turkey by sanjaks before the war (see footnote 4). The line of heavy dots represents approximately the northern and eastern boundary of the Arab lands.

Fig. 2—Density of population in Asiatic Turkey by sanjaks before the war. In conjunction is shown the proposed division of Turkey by the Treaty of Sèvres (solid lines) and the Tripartite Agreement (broken lines): Zone of the Straits, Greek zone in the Smyrna district, Italian zone in southwestern Anatolia, French mandatory area in Syria and zone of influence in southeastern Anatolia, British mandatory area in Mesopotamia and Palestine. The dot-and-dash line represents President Wilson's boundary on the Turkish side for the proposed state of Armenia.

Economic Aspects

The disposition of the main bodies of population about the rim of the Anatolian peninsula takes on a further significance if examined in conjunction with the map showing railroads and port statistics. The dry interior of the peninsula being ill served with railroads, it follows that sea communication between the different parts of Turkish territory (as cut down by the Treaty of Sèvres) is vitally affected by the control of the Bosporus. Upon this historic strait focuses the national life of Turkey. It is by ship and caravan that the principal trade of Turkey is transported; the era of railroad building has only begun. The representation of port statistics shows graphically that the interest of Constantinople and of the Anatolian peoples in the Aegean Sea is of the first order, a fact not to be overlooked when appraising the historic position or trade or ambitions of the Greeks.

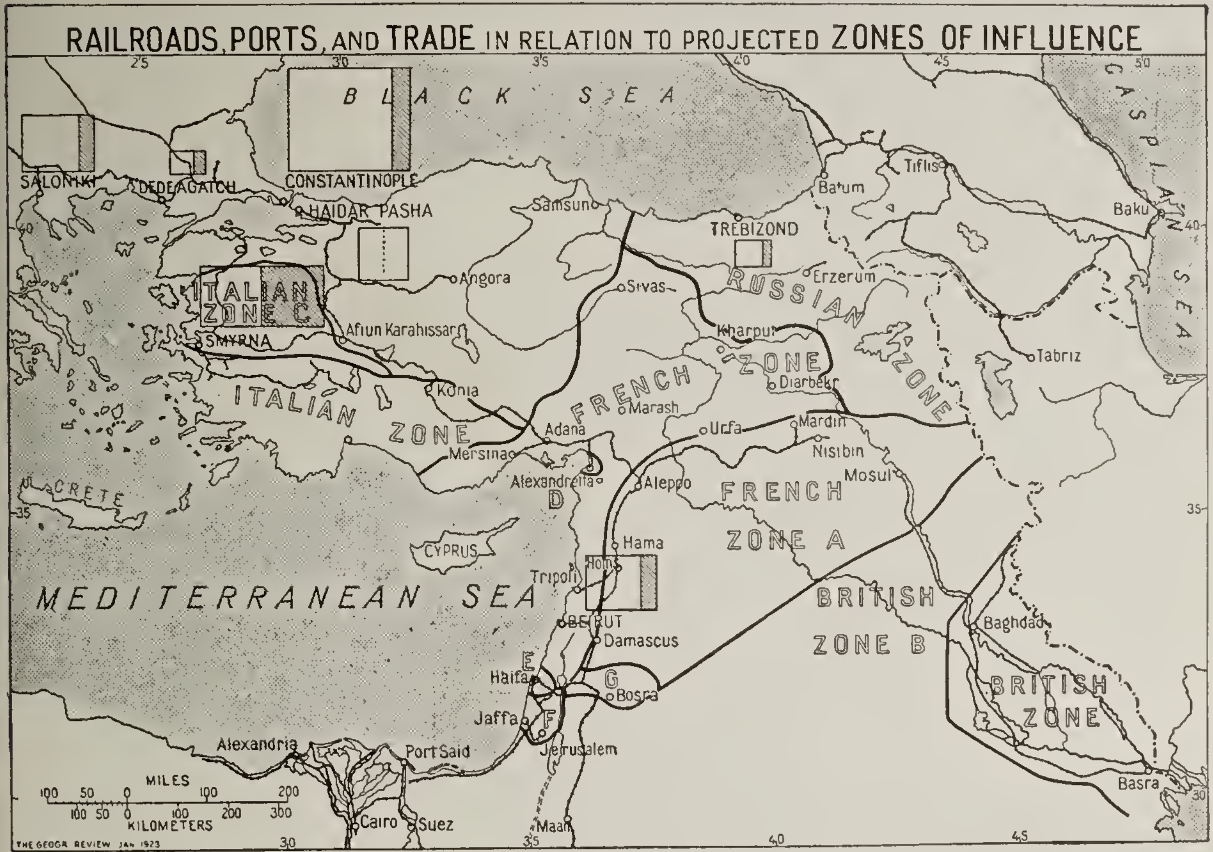

FIG. 3—Adjacent to the principal ports are rectangles representing proportional value of trade—the open portion, imports; the shaded portions, exports. Statistics are for 1910–1911, that is before the Balkan wars in which Turkey lost the majority of her European holdings. The railway net is for 1922. Zones of influence are drawn as laid down in the Secret Treaties. A, B, C are supplementary zones; D, E, F, G are special areas mentioned in the various agreements. Compare with Figure 2.

Smyrna is the chief exporting center, and Constantinople leads in imports. The statistics for the seven ports are as in Table I.

The territorial losses of the Balkan wars deprived Turkey of Saloniki and Dedeagatch, two of the seven ports of chief importance. The prospective loss of Smyrna to Greece, of Beirut to France, and of Trezibond to Armenia together with the inclusion of Haidar Pasha in the zone of the

Straits and the special régime of Constantinople (with its tributary territory in Europe reduced to the needs of water and vegetable supplies) placed practically every outlet of Turkish trade in foreign hands.

TABLE I—COMMERCE OF THE PRINCIPAL PORTS OF THE TURKISH EMPIRE (1910–11)
(*Percentage*)

	IMPORTS	EXPORTS
Constantinople	31.48	9.00
Smyrna	10.87	20.60
Saloniki	10.64	5.04
Beirut	9.98	4.66
Haidar Pasha	Total of 5.94	
Trebizond	2.24	1.28
Dedeagatch	1.65	1.82

Total value of exports in 1910–11	$80,000,000
Total value of imports in 1910–11	150,000,000

Were the interior of Turkey a closely organized agricultural unit the loss of coastal outlets might have been less serious. On the contrary, the arable lands of the peninsula lie for the most part near the sea in patches and narrow belts or tongues of valley floor or on the lower soil-covered hill slopes. Elsewhere, and notably in the steppe-like interior, the pastoral-nomadic type of life prevails. Because this life is on a more primitive level than in Europe it follows that the Turk could afford to waste his land and people without fearing for their future if he could in the end recover the coastal outlets.

Moreover, another geographical element enters into the present situation. The Turk has been fighting on his own distant ground, and the Allies have had to come to him; and that is costly. Here time has told on the side of the Turk. It was, therefore, logical to conclude that the Treaty of Sèvres and the supplementary Tripartite Agreement of even date (1920) between Great Britain, France, and Italy would have no validity at all unless the Turk agreed. The Allies could not force him to accept their terms.

TURKEY'S TERRITORIAL GAIN IN THE ANGORA AGREEMENT

The first step in Turkey's territorial advancement over the Treaty of Sèvres was made in the military confines bordering northern Syria. Down from the northeast runs a string of valleys towards salt water at the Gulf of Alexandretta. By the Treaty of Sèvres France encircled that outlet, whence a considerable trade reaches the coast and where fertile lands already productive are susceptible of still greater development. It is not a principal Turkish outlet, but it is an important one. By the Angora Agreement (1921) it was recovered by Turkey though France still retains an economic priority in the vilayets of Adana, Diarbekr, Sivas, and Kharput—virtually the French zone of the Secret Treaties and of the Tripartite

Agreement. Of chief importance in the region is the Cicilian plain. While the northern part is gravelly and dry and supports a population chiefly nomadic, the southern half has a fertile soil abundantly supplied with water available for irrigation. In recent times Egyptians, Syrians, Bulgarians, and Circassians have colonized it and notably displaced the old Turkish population.[5]

SMYRNA, CONSTANTINOPLE, AND THE STRAITS

As soon as the Angora Agreement had gained them the first of their essential outlets the Turks turned to Smyrna. Smyrna is far and away the largest export port of the Turkish realm. Besides it is the center of one of the few really dense populations of Turkey. Nothing could be more certain either from the historical or the commercial standpoints than that it would become one of the chief objectives of the Turkish army. With Smyrna in his hands Mustapha Kemal Pasha turned to Constantinople; and, though he had no fleet, it was obvious at the beginning that he would try to enlarge his European holdings and get control of Constantinople also as a basis of negotiation and compromise. By this act he would regain the capital and the greatest importing city of the Turkish Empire. Second only to the recovery of Constantinople as a symbol of power and prestige throughout the Mohammedan world is that of the European hinterland—eastern Thrace with Adrianople. Before the Turk had reached the Golden Horn, Adrianople had been his European capital. In 1913 Turkey had put forth her "historic rights" to the city and had recovered it by agreement with Bulgaria at the close of the Second Balkan War, thus modifying the Enos-Midia line upon which they had agreed at the close of the First Balkan War.

The present situation finds the Allies not unprepared for concessions. In March, 1922, the Allied Ministers at Paris had already proposed substantial departures from the Treaty of Sèvres. Two prime objectives were, however, retained—protection of Christian minorities and freedom of the Straits. In this last point lies the crux of the entire situation. Unlike the other territorial questions this of the Straits is primarily of international importance. Attention has already been called to the economic value to Turkey of the western waterways of the old Empire, in particular of the ports of Smyrna and Constantinople, but there is also the trade of the Straits distinct from that of the bordering ports. The Straits is one of the great maritime passages of the world. Up to 1910 the movement of shipping surpassed that through Suez.

THRACE

The debatable ground of Thrace has long been a political storm belt. Turk, Bulgar, and Greek meet there in an environment that offers something congenial to all three races. The present division of territory is only the last of a long series made to establish boundaries where no natural or ethnic divisions in truth can be found.

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[5] Ewald Banse: Die Türkei: Eine Moderne Geographie, 3rd edit., Brunswick, 1919, p. 175.

Elsewhere in the Balkan Peninsula two (or rarely three) powers have been in conflict over disputed territory, whereas in Thrace at least five groups of interests are in conflict. Greece has sought to encircle Constantinople and shut off Bulgaria from the Aegean as well as Turkey from Europe. Bulgaria has persistently sought a territorial and commercial outlet to the Aegean on the south. Turkey has resisted both Greece and Bulgaria, and in 1920 the Powers put into force a special régime for the Zone of the Straits that introduced a fourth group of interests. The trade of Russia gives her also a primary interest as a fifth power.

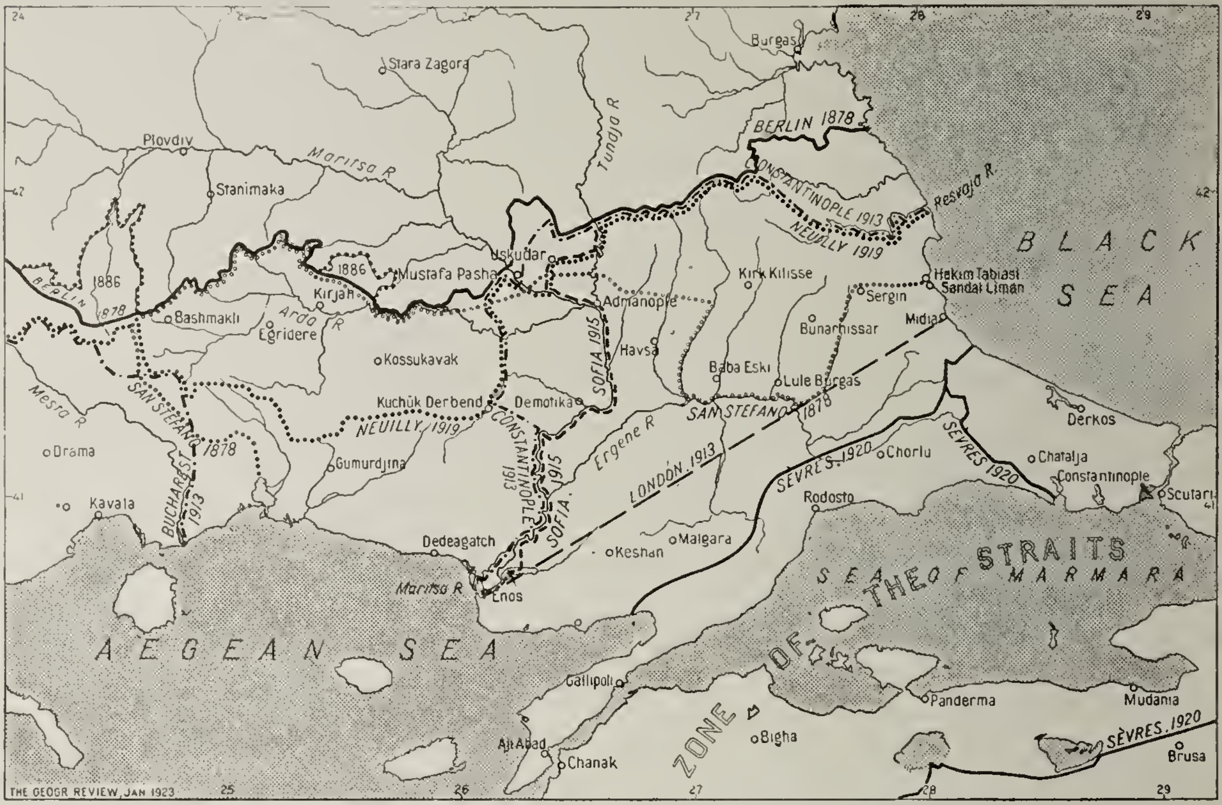

FIG. 4—Sketch map illustrating the political geography of Thrace. Boundaries established by the following treaties are shown: San Stefano, 1878; Berlin, 1878; London, 1913; Bucharest, 1913; Constantinople, 1913; Sofia, 1915; Neuilly, 1919; Sèvres, 1920.

The positions of the various treaty lines are geographically interesting. The line of San Stefano followed natural features in western Thrace; in eastern Thrace it would have produced serious dislocations in the life of that time, because it cut across the grain of the country owing to the absence of dominating natural features that run in an east-west direction. The Treaty of Berlin that superseded it put the line in a more natural position, in closer relation to minor watersheds northeast of Adrianople while still retaining the natural features of river (Arda) and mountain crest (Black Balkans) in western Thrace for a considerable distance. The Treaty of Constantinople between Bulgaria and Turkey (1913) provided for a frontier on the Maritsa River for a short distance above its mouth. It then ran west of north, cutting across drainage and relief in such a way as to encircle Adrianople at a distance, while it gave Bulgaria on the border of the Black Sea a block of territory whose southern margin followed the Resvaja River. The changes stipulated by Bulgaria in 1915 as part of the price of her entry into the World War placed her frontier on the Maritsa River opposite Adrianople and also gave her ownership of the *left bank* of the Maritsa. The border of the Zone of the Straits and of the Constantinople zone of the Treaty of Sèvres on the north side of the Sea of Marmora took advantage of natural features only to a limited degree, for the special régime under which these two territories were to operate was itself designed to provide flexibility of frontier arrangements.

The Turkish victories of the past few months have brought the Turk into the problem again. Further modification will come no doubt both here and in northeastern Turkey where the Armenian boundary was projected and where the State of Kurdistan was outlined by the Treaty of Sèvres.

At the present writing (Dec. 2, 1922) the question of Mosul and its oil fields has also been brought into the Turkish settlement. The British mandatory area, as at first proposed, encircled the oil district and this position was incorporated into a treaty (Sèvres) only when France had relinquished an overlapping territorial claim in return for the privilege of securing one-fourth of the oil produced in Mesopotamia. France also gave the British the right to build oil pipe lines to the Mediterranean across the French mandatory area in Syria in return for the privilege of buying one-fourth of the oil that may be piped in this way from Persia.

The agreements between France and Great Britain, mentioned above, were all based upon the supposition that Turkey would sign the treaty of Sèvres. But the recent Turkish successes have definitely put that treaty aside and also reopened the question of oil; just as in northern Syria the Turkish successes of 1921 obliged the French to modify their limits of control about the head of the Gulf of Alexandretta. The problem can hardly be expected to be solved without further changes in the political map of the Turkish Empire, since irrigation possibilities, oil reserves, and strategical considerations make Mesopotamia a highly desirable block of territory—to the British, with Egyptian and Indian territory on either hand and an oil-burning navy, no less than to the Turk trying to piece out his national domain and recover some part of his former economic strength.

Traversing the British and Turkish interests are those of Mesopotamia (Iraq) itself. If King Feisal looks at the political map and gives a thought to oil and irrigated land and trade routes he may well become a deciding factor. In any event the political geography of the Near East promises to have more rather than less significance as the underlying causes of boundary changes come one by one to the front.

FUTURE WHITE SETTLEMENT: A REJOINDER

By Griffith Taylor

In response to Professor Willcox's comments in the October (1922) number of the *Geographical Review* on my article, "The Distribution of Future White Settlement," I wish to state that:

1. With regard to extending the wheat boundary in the future, the same unconvincing argument crops up in Australia. Wheat culture may be pushed forward many miles into the arid or cold regions owing to scientific research. But I would ask my critics *to plot* on a map the increased areas thus gained. I think they will see that these new regions of moderate and somewhat precarious crops *bulk very little in comparison* with the optimum belts; which latter, moreover, will probably be *growing in importance* while the outer fringe is advancing. Such crops do not essentially affect the *vast areas* unsuited for agriculture. (It is not, I think, legitimate to quote extensions in the past made before the climatic controls of wheat were fairly understood.)

2. I fear that I still hold that the health (including also in this term the idea of a *comfortable* existence) of the white race is, and will be, much more controlled by climatic factors than by "individual family and social action."

3. I regret that I did not clearly quote my authority for my statement that the world's population has doubled in the last ninety years. Mr. Willcox rather gratuitously assumes that I had no basis for this statement. If, however, he will turn to the report which I quoted seven lines further on, he will find that the Commonwealth Statistician (on page 33) discussed this problem and shows graphically that the world has doubled its population from 1820 to 1920.

4. My answer to the comments on the growth of population of the United States is that I am the last person to imagine that one can accurately foretell the world's population in 200 years. Hence it seems superfluous to apologize for the small differences between the figures (expressly termed "approximate") which I quoted (25, 50, and 100) and the more accurate figures, (23, 50, and 92), which I am willing to accept. The difference falls well within the "error of the experiment," but the main argument is not greatly affected.

5. The declining birth rate as a potent factor in the problem is expressly mentioned in the last paragraph of my paper. Hence I think that the chief difference between Mr. Willcox and myself is that he does not yet fully appreciate the importance of the physical environment, whereas I can see no reason to doubt that it will continue to be the chief agent in determining the habitats of the human races.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

Meetings of November and Elections to Fellowship. The first regular monthly meeting of the American Geographical Society for the season of 1922–1923 was held on November 21 at the Engineering Societies' Building, 29 West Thirty-ninth Street. President Greenough presided. There were presented with the approval of the Council the names of 375 candidates who were duly elected as Fellows of the Society. The Society was then addressed by Mr. Carl E. Akeley, of the American Museum of Natural History, on "The Gorillas and Volcanoes of Kivu." The lecture was illustrated by moving pictures taken on his African expedition of 1921–1922. Mr. Akeley is inventor of the Akeley moving picture camera and a former president of the Explorers Club.

On December 26 Dr. Charles Upson Clark will address the Society on "Transylvania: the Rumanian Switzerland."

Dr. Clark visited Rumania in 1922 for further studies. He is the author of a book entitled "Greater Rumania." Fellows of the Society will remember his extremely interesting lecture on Rumanian life and geography in 1920 and his lecture of 1918, "Fighting Above the Clouds." For several years Dr. Clark was Director of the School of Classical Studies of the American Academy at Rome.

Recent Publications. A little more than two years ago the Society resumed its full program of publication and is able to announce fourteen monographs and two maps now available for distribution. Among these is a timely book entitled "The Earth as Seen from the Air," by Willis T. Lee of the U. S. Geological Survey. There are nearly seventy airplane photographs and a number of maps. It represents a year's work of which a large part was spent in the field under highly favorable conditions of flying. The book is printed on heavy coated paper in large type and bound in heavy gray covers with black panel. It is a contribution of the first order to what may be called airplane geography.

In the study of man it is important to know his relation to past climates that affected his way of life and geographical distribution. The records of history contain part of the story, the rings of growth of the Big Trees of California contain another part. What is now needed is to connect these elements with the latest phases of the great Ice Age. Baron Gerard De Geer discovered that this could be done in Scandinavia by studying the thickness and sequence of layers of clay deposited in fresh-water lakes now extinct; and his pupil, Dr. Ernst Antevs of Stockholm, has applied De Geer's methods in New England with the result that we now know that it took over 4000 years for the great continental glacier to retreat from Hartford, Conn., to St. Johnsbury, Vt. The method and the results are published in "The Recession of the Last Ice Sheet in New England," illustrated with photographs, graphs, and a colored map.

When England and Spain were building their great colonial empires in the West, Peter the Great of Russia was encouraging the exploration of the vast spaces that lay between the Urals and the Pacific. In his service, Vitus Bering, a Dane, was appointed leader of a great expedition that was to lift the veil that lay over the northeastern edge of Asia and the northwestern corner of North America and to place upon the charts for the first time the coastal outlines of the region and establish the true relation of Asia and America. The official records of Bering's two expeditions have never had adequate publication in English. Bering's report on the first expedition, the journal of the companion vessel, the St. Paul, by Chirikov, his second in command, as well as five chapters of text description and comment, are published in a book entitled "Bering's Voyages." These documents relating to the second expedition are published for the first time, having been translated from the originals in the Russian archives. There are included manuscript maps and unpublished drawings of Aleuts, from the Russian archives, and a facsimile of Peter the Great's orders for the first expedition, with comments in his own handwriting. The book contains a chart of the second expedition, in 1741, based on the log books. This is a modern reconstruction of the tracks of the two vessels of the expedition adjusted to the actual lay of the land, which had never been done before for the whole voyage. A companion volume under the same general title will be published in 1923 and will contain the account of the sea voyage on the second expedition by G. W. Steller, the naturalist of the expedition.

In the same year that the Society published "Bering's Voyages," relating in large part to the coast of Alaska, it had the appropriate task of compiling and drafting a map of Alaska for the Alaska Road Commission. The map is on the scale of 1:1,250,000, or about 20 miles to the inch. It measures about 60 by 50 inches over all and is printed in five colors. It has been compiled from at least 170 principal sources and is a great advance over any existing map of the territory. It shows contours so far as they have been determined, railroads and various classes of roads and trails, telegraph and wireless stations, lighthouses, and national forests and parks. It will serve in the development of Alaska's resources of coal and oil, forests, reindeer meat, water power, and the like. It will also serve the tourist and mountain climber.

A second map produced in 1922 is the La Paz sheet of the Millionth Map of Hispanic America. It is printed in twenty-two colors. It includes the disputed Tacna-Arica area on the common frontier of Peru and Chile, takes in the Maritime Cordillera of northern Chile and Cordillera Real of Bolivia and the high plateau between with its salt marshes and interior drainage, and a portion of the Pacific floor in an abyssal region, the Krümmel Deep. It conforms in most respects with the International Map of the World and is the first of 100 sheets which together will constitute a great atlas of the Hispanic American realm.

The La Paz sheet is accompanied by a handbook entitled "The Geography of the Central Andes" by Alan G. Ogilvie of the staff of the Society. It contains 250 pages and has two large maps of population and the use of the land on the scale of 1:2,000,000, besides 41 photographs and sketches. The book represents modern standards in regional description and deals with plant and animal life, minerals, climate and soil in relation to the life of Highland Bolivia and the adjacent lowland on either side, one wet tropical and the other coastal desert. The cartographic sources of the La Paz sheet are given, and there is an extensive bibliography.

The collections of the Society include a considerable number of rare maps and books of importance in the field of historical geography. On account of its rarity and value, one of these items was reprinted in 1922. It is entitled "A Short Account of the First Settlement of the Provinces of Virginia, Maryland, New-York, New-Jersey, and Pennsylvania." Only seven copies of the original are known; two in the Harvard College Library, one in the Library of Congress, two in private possession, one in the Newberry Library at Chicago, and one in the library of the Society. The booklet was printed in a limited and numbered edition on handmade paper, in original Caslon type, and included a facsimile reproduction in color of Captain John Smith's map of 1606, with extensions by John Senex accompanying the original. It gives a brief narrative of the progress of sixteenth and seventeenth century settlement along our Atlantic seaboard.

Two publications of special interest to scholars deal with bibliographical matters. The first is entitled "Bibliographical Aids in Geographical Research," by Dr. John K. Wright, the librarian of the Society. This book aims to help the student of geography in his search for printed material. It is a critical guide to various bibliographical tools and periodicals of geography and of its allied natural, historical, and economic sciences. Sections are also devoted to general bibliographical reference books and to guides to government publications and maps.

The second item grows out of the program of research of the Society in the field of Hispanic American geography. It is entitled "A Catalogue of Geological Maps of South America," by Henry B. Sullivan of the U. S. Geological Survey. It includes a technical description of over two hundred geological maps and is accompanied by an index map of the geological maps of South America which shows the position of each one on the continent. Alternate pages are left blank for additions by the user and for notes on the maps themselves.

There has also been prepared a "List of Maps of Hispanic America: I. Maps Contained in Periodical Publications." It consists of a typewritten list of maps arranged by countries and is bound in octavo.

Distribution of Title Page, Contents, and Index of Volume 12 of the "Geographical Review." The title page, table of contents, and index for Volume 12 of the Geographical Review (1922), which is issued separately, is ready for distribution. Copies are sent to all institutions exchanging publications with the Society and to individuals who request that their names be put on a list for this purpose.

NORTH AMERICA

Aboriginal Geography of New York State and City. Two recent books devoted to the aboriginal archeology of New York state and city contain materials of distinct geographical interest. The first, by Arthur C. Parker, is entitled "The Archeological History of New York" (*New York State Museum Bull. Nos. 235–236*, July–August, 1920, Albany, N. Y., 1922). A background is supplied by a brief survey of the origins of early man, his probable course of migration from the Old World into the New by way of Alaska, and his distribution throughout North America. An important chapter is devoted to the "Physiographic Features [of New York] Inviting Occupation:" particularly the easy communication by water and land, the abundant supply of food, and the climate which by the warmth of its summers admits of abundant harvests and by the cold of its winters conduces to mental and physical vigor. Mr. Parker thinks it no fortuitous circumstance that New York state should have been held by the most able mentally of all the North American tribes. Physiography influenced the location of Indian trails and town sites. The level lines of abandoned lake beaches were the natural routes for trails, destined to be followed, when the white man came, by wagon roads and railways. At convenient landing places and portages Indian settlements sprang up, often the precursors of modern towns and cities.

The artifacts collected throughout New York show evidence of several different stages of Indian occupation prior to the coming of the Iroquois, perhaps some 600 years ago: Eskimoan or "Algonkian tribes intermarried with the Eskimo"; Algonkians; and peoples of cultural affiliations with the mound builders of Ohio (about whom there has been much farfetched speculation). By means of sketch maps Mr. Parker shows the areas influenced by the material cultures of these various folk. The Algonkians seem to have followed the main watercourses throughout the length and breadth of the state; the people of mound-builder culture kept to stream and lake shore in the center and west; Iroquois civilization also predominated in the western half of the state, though Iroquois remains have been found generally throughout, except in the Adirondack wilderness, which seems to have been consistently avoided by red man and white man alike. Mr. Parker thinks that the Iroquois came to New York from the southwest, possibly from the lower Ohio valley.

Reginald Pelham Bolton's "Indian Paths in the Great Metropolis" (Indian Notes and Monographs, Museum of the American Indian, Heye Foundation, New York, 1922), will delight all students of the local topography and antiquities of New York City. From archeological remains, historical records, old maps, and inference Mr. Bolton has succeeded in reconstructing and plotting upon a series of maps the probable routes followed by the Indian trails of Greater New York and its environs. These trails "ran not only between the several stations of a single tribe or chieftaincy, but were highways of communication between very diverse peoples." Manhattan Island seems to have been a natural nodal point toward which the Indian routes converged from all directions. The detailed track of these routes was determined by conditions of terrain, the shortest distances consistent with the avoidance of obstacles, particularly marshland and steep grades. When the early white settlers arrived, they built their wagon roads along the lines thus marked out, and these early roads were often followed by post roads and by the main arteries of automobile traffic of the present day. Broadway and the Boston Post Road as they approach Manhattan from the north and northeast are lineal descendants of Indian paths in the forest. These joined at a "wading place" through Spuyten Duyvil Creek where Broadway now enters Manhattan Island. Thence a trail ran down the whole length of the island to settlements at its southern extremity whence there was an easy ferry over to the Long Island shore. Some parts of this longitudinal trail are represented at the present day by certain of the main highways of New York, notably St. Nicholas Avenue, the Bowery, and lower Broadway from Fulton Street to the Battery.

The Wilderness Road to Kentucky. There is no trail in America more deeply associated with all that is characteristic and significant in American life than the Wilderness Road which lay between Virginia and Kentucky. Boone blazed it in 1775 on the basis of the best information gleaned from explorations of his own and of others. It was, for nearly three decades, the main channel of communication between the seaboard states and the new settlements in Kentucky. Then its importance waned.

The reason for its rise and fall lay in the fact that it was an adaptation to a peculiar situation. The American frontier had been pushed west to the mountains beyond which beckoned the great fertile areas of the Mississippi valley. There were easier passes across the mountains than the Wilderness Road. One was the Mohawk valley, later to become the greatest of all, but in Boone's time it was blocked by the powerful and warlike Iroquois. There were roads across Pennsylvania to Pittsburgh at the origin of the Ohio. Many used these in going out to Kentucky; but the uncharted river was dangerous, and in the country north of it lived the Indians that Wayne fought at Fallen Timber and that Tecumseh gathered into an ill-fated confederation on the eve of our second war with England. Moreover, the journey eastward from Kentucky to Pittsburgh was against the current. The country on the west of the southern end of the Appalachians was dominated by the warlike Cherokees, kinsmen of the Iroquois. Between these southern Indians and those of the Ohio and Indiana country lay Kentucky, a neutral ground.

Kentucky was, therefore, the place of the first important American settlements west of the mountains. Long and difficult though it was, the Wilderness Road was practically the only feasible route to the west. Over it went most of the men and women and most of the goods that made civilization beyond the mountains possible. Its importance lasted until the power of the Indians was broken at Newtown and Fallen Timber, Tippecanoe and Horseshoe Bend. Then better routes across the upland barrier could be utilized. Today it is off the beaten track, and some of its stretches have long been abandoned. But to its name still clings the memory of those thousands of pioneers, making their way with fear and hope through the long two hundred miles of mountainous desolation to the homes that were to be in the plains beyond.

Three times has the history of the trail been written; but it has remained for a physician, William Allen Pusey, to determine as nearly as possible its exact location. His work has been thoroughly done, and his book, "The Wilderness Road to Kentucky" (New York, 1921), makes a lasting contribution to the literature of the historic highway. He has plotted on topographic maps of the U. S. Geological Survey the small details of practically the whole of the route. Numerous illustrations and an illuminating text give vividness to the book; but the lack of an index is regrettable.

An interesting sequel to the story of the Wilderness Road may be found in "The Natchez Trace," by R. S. Cotterill, in the *Tennessee Historical Magazine* for April, 1921 (issued June, 1922). The products of the early Kentucky settlements beyond what were needed at home were floated down the Ohio and the Mississippi to New Orleans, the mountains preventing their carriage eastward. Some products went in keel boats that could be poled laboriously back up the river, but most floated down in great flatboats that were broken up and sold for lumber at the journey's end. The boatmen who handled them made their way on foot or on horseback back to "Kaintuck" along the "trace" from Natchez throughout the country of the Chickasaws and Choctaws to Nashville and from Nashville to Lexington. This trail with its drinking, fighting bands of boatmen, "half alligator and half horse," according to their own proud boast, had its own picturesqueness. Its story preserves a phase of American life that passed with the frontier.

Ralph Gabriel

The Inland Lakes of Michigan. Five thousand has long been the round number accounting for the inland lakes of Michigan, whose exact number is still not definitely known. It is estimated that these bodies of water, varying in area from a lake of some thirty-one square miles to a pond too small to be named and forming but one among seventy in an area of a single square mile, occupy about one-fiftieth of the total area of the state, or about 12,000 square miles. If they were drained they would add much valuable land to the acreage of the state. As it is, however, many are a valuable asset. One thinks first of Michigan's fame as a summer resort and as a fruit-growing state: for each of which no small credit is due to the modifying effect upon atmospheric temperature exercised by this host of small lakes, overshadowed though they may be by the influence of the Great Lakes. Of lesser and more local importance is the service which these lakes perform as natural reservoirs accommodating, with only a slight increase in level, the waters of the spring freshets and lessening thereby the flooding of tributary streams and the stripping of the soil. Added to this is the local use for power, irrigation, and city water supply effected by damming the outlets.

A study of any of these lakes, whether for scientific interest or utilitarian purposes, would necessarily include the origin of the lake, the action of wind and wave and ice on its shores, the possibility of extinction by vegetable growth or developing drainage. The basis for such a study is given by Professor I. D. Scott in "Inland Lakes of Michigan" (*Michigan Geol. and Biol. Survey Publ. 30, Geol. Ser. 25*, Lansing, 1921). The monograph includes a general study and classification of the inland lakes of Michigan and treats several examples in detail.

The present surface features of Michigan are largely due to a veneer of drift left by the last ice retreat. The lakes of the state are predominantly of glacial origin, and their existence is an indication of the present incomplete drainage of this morainal veneer. Physiographically Michigan is divided into seven natural regions. In the Northern Peninsula are the Western Highland, which averages 1000–1200 feet above Lake Superior; and the Eastern Lowland, averaging more than 1000 feet lower than the highland. In the Southern Peninsula the physiographic provinces have a southwesterly-northeasterly diagonal trend. In the southeast is the Lake Erie Lowland, bordered to the northwest by the Thumb Highland. Bordering this Highland is the Saginaw Lowland, running from Saginaw Bay southwest to the central part of the state where it meets the Michigan Lowland which follows the lake for some distance north and south. The two form a great lowland belt across the state and are bordered on the north by the Northern Highland. In both Northern and Southern Peninsulas the lakes are largely confined to the moraines of the lowland provinces.

At least six types of lakes of glacial origin have been noted. There are also, as might be expected in a state with so much shore line, many lagoons. In addition is a much lesser number of lakes of diastrophic origin, mainly rift-valley and ponded, and, along the river courses, the familiar oxbow lake.

Nitrate Deposits of Southeastern California. There have long been rumors of the existence of workable nitrate deposits in the arid regions of the West. Scientific investigation of reported occurrences received a great stimulus during the war, and a result is the recently published "Nitrate Deposits in the Amargosa Region, Southeastern California" (*U. S. Geol. Survey Bull. 724*, Washington, D. C., 1922), an examination of one of the most promising localities.

The Amargosa River enters Death Valley by a long, open basin that may be considered as a southward extension of the valley. Nitrate beds occur in a narrow belt along the southwestern margin and also farther upstream where in places the valley assumes a canyon aspect. The deposits are associated with clay beds of Tertiary age deformed since deposition and now outcropping in more or less isolated hills whose light color and rounded contours contrast strikingly with the rugged and highly colored mountain walls enclosing valley and basin. The nitrate is found in the *caliche* layer lying beneath a superficial soil covering and somewhat similar to the *caliche* of the Chilean fields. It is thus quite distinct from the widespread but valueless deposits of so-called "cave" nitrates.

The investigation shows that nitrate is present in extractable quantities but that under existing conditions it could not be worked in competition with the Chilean product. The higher grade deposits are patchy and scattered, and even in these the percentage of nitrate is low. In addition to difficulties of transportation and mining imposed by the topography, there would be seasonal limitations on systematic exploitation. In the article "Death Valley—the Hottest Known Region" (*Monthly Weather Rev.*, Vol. 50, 1922, pp. 10–13) A. H. Palmer gives an account of the climate of Greenland Ranch, an irrigated spot on the eastern edge of the Valley. During the decade 1911–1921 the mean temperature of June was 94°; July, 101°; August, 99°; September, 89°. In July and August the mean maximum temperatures were 115.7° and 114° respectively, and the extreme maximum was 134°. It is believed that this is the highest natural air temperature on record as an undisputably reliable observation.

EUROPE

The Character and Origin of the Frisian Islands. The March, 1921, issue of *Annalen der Hydrographie und Maritimen Meteorologie, Zeitschrift für Seefahrt- und Meereskunde* contains a discussion, by Dr. Walter Behrmann, of the character and origin of the Frisian Islands. From the Channel to the Jutland coast the North Sea is framed by a wall of sand dunes fringed by a sandy beach gradually descending into the sea. From Calais to Blankenberg the wall is unbroken except for the mouths of a few streams. Even where the Rhine makes a very wide breach the islands of Walcheren, Schouwen, and Goeree remain to indicate the presence of the wall. At the Hook of Holland the wall closes again and curves unbroken as far as The Helder. There the wall breaks again to form the Frisian Islands. Coast and islands bend in a smooth curve from a north-south direction to east-west and then back to north-south again. Juist and Nordeney, however, do not follow the curve but thrust out northward into the sea.

Two problems are suggested: (1) the origin of the material from which the dunes are built; (2) the agent which has caused the breaches in the wall. The natural answer is that the material is either river sediment or the products of wave erosion brought from the French or English coasts, while the breaches are formed where rivers empty into the sea. The dunes, however, consist of layers of pure quartz sand separated by layers of sea débris—slag from English furnaces, coal dust from passing ships, seaweed. The sediment carried by the Rhine and other rivers of the region is mud, not sand. The seacoasts which might furnish the material are chalk cliffs. Also, the suggestion that river mouths have caused the breaks in the wall does not explain those breaks where there is no river mouth.

Dr. Behrmann finds an apparent solution in the dunes of Heligoland which consist of a sand hook so protected by the island that no material brought by the waves could reach it. The material which forms this hook, he considers, is from the sea floor itself, which he believes and which soundings show is covered by the same glacial drift that forms the North-German plains. It is well known that storms stir this part of the North Sea to a grayish color, the color of quartz sand in suspension. During the war this gray color was an indication of the whereabouts of submarines lurking on the sea bottom. This suspended sand is built into dunes not during storms when the action of the waves is destructive rather than constructive but in the lull after the storm while the sand is still in suspension. Each little wave then brings its load and, as it falls back with its momentum retarded, deposits part of that load. The tides play an important part, the deposition being greatest at the ebb.

As to the formation of the breaches in the wall: the west winds bring two currents into the North Sea from the Atlantic by way of the channel between the Shetland Islands and Faroes One enters along the Norwegian coast, the other along the Scottish. A third current, entering by way of the Channel, gives to these a circular motion whose direction south of the Frisian Islands is coastwise so that its action, except in time of storm, is constantly one of gentle deposition, whereas in the Frisian Islands the direction of the current is toward the coast. As a result the breaches made by storms are kept open and enlarged while the islands themselves, beaten upon by the storms, have a high dune on the west and a sloping beach on the east. Dune and slope move constantly slowly eastward.

Irrigation in the Alps of Piedmont. *La Geografia* for May–August, 1922, contains a study by G. Roletto of irrigation in the Alpine valleys of Piedmont between the northern watershed of the Dora Riparia valley and the southern watershed of the Val Varaita. The writer's purpose is to correlate the physiographic facts of this region with the distribution, density, and character of irrigation and these, in turn, with the outstanding elements of the economic life. The details of these correlations are of purely local interest, but from them emerge certain generalizations to which it seems worth while to call attention.

Irrigation is here necessary partly because of the highly permeable glacial and other formations which underlie so much of the productive land and into which the water is rapidly absorbed, and partly because of a relatively low precipitation during the summer months—the growing season of meadow and field crops. The valley floors fail to offer broad enough expanses of meadowland to produce sufficient fodder to last through the winters. Consequently at as early a period as the Middle Ages the peasants were obliged to seek for upland meadows and pastures and, in order to make these productive, to construct elaborate systems of irrigation. Though many of the latter have been abandoned of late years, the essential fact of irrigation at widely diverse levels still prevails in association with the seasonal migration from the valleys to the heights which is such a striking characteristic of Alpine pastoral economy (see Philippe Arbos: La vie pastorale dans les Alpes Françaises, Paris, 1922).

The upper level of existing irrigation in this part of Piedmont corresponds generally with the upper level of permanent habitation, diminishing from elevations of 1800 meters back in the mountains to 300 where the valleys open out upon the plains. The intensity of irrigation in relation to the total agricultural production, to the areas of meadow, pasture, and cultivated field, and to the density of population varies widely from place to place but bears an intimate connection with local conditions of slope, drainage, soil, etc., on the one hand, and with various demographic factors on the other. In the valleys, where the intensive cultivation of fields prevails, there are broader surfaces under irrigation in proportion to the population than on the slopes and uplands. The zone of cultivated fields is also the zone of the lowest percentage of emigration.

There is little uniformity in the customs and usage of irrigation. Proprietary rights are vested here in the users of the water, there in private individuals, elsewhere in the communes. There is an immense diversity of regulations governing the utilization of the water. Throughout large areas no fixed times are set when the water is distributed; in other localities this is done once a week, elsewhere on holidays, still elsewhere every fifteen days, and so on. The customs of nomadism are also multiform and are divided by Roletto into no less than four main types and several subtypes.

The irrigation and consequent use of remote meadows and pastures have led to the construction of storehouses or barns (*grange, ciabot*) for the temporary accumulation of the fodder before this is finally carried to the permanent villages to be stored for the winter. At the present time many of these barns are being abandoned. One reason for this is the improvement of roads and other lines of communication which make it more convenient to transport the crops directly to their final destination, but a more potent cause is "the slow but inexorable descent of the pastoral population toward the valleys" and consequent relinquishment of the exploitation of the high meadows and of human constructions connected with them. Roletto acknowledges in his conclusion that here, for the time being at least, man is losing ground in his everlasting struggle with environment. This ground may perhaps be regained and a great future may lie in store for these valleys if the example of Switzerland be followed, where the impounding of water for purposes of irrigation has been utilized in conjunction with the development of waterpower.

AFRICA

The Census of 1921 in French North Africa. The beginnings of the modern French colonial Empire may be said to date from the capture of Algiers in 1830. Thence French control has been extended east, west, and south, culminating in the recent establishment of connections with West Africa across the Sahara. There is thus created a solid French block in northwest Africa with a population estimated at 25,000,000 to 26,000,000, over three-fifths that of France. French North Africa (Algeria, Tunisia, Morocco) accounts for half this figure according to the census of 1921. Two main interests are manifested in the detailed results of the census—the number and distribution of the total population, regarded as economic and military assets, and the number of the European element in this total population (Augustin Bernard: Le recensement de 1921 dans l'Afrique du Nord, *Ann. de Géogr.*, Vol. 31, 1922, pp. 52–58 and note, Vol. 31, 1922, p. 382; Raymond Peyronnet: À propos du recensement de 1921, *Bull. Soc. de Géogr. d'Alger et de l'Afrique du Nord*, Vol. 27, 1922, pp. 340–359).

The total population of Algeria is 5,806,090, representing an increase of 2.5 per cent over that of the last decade. This disappointingly small increase is explained as a consequence of the war, followed by the famine of 1920, though this was far from being as serious as that of 1867. During the period 1876–1921, following the introduction of direct administration, the native population doubled. In some sections, notably in parts of overpopulated Kabylia, the population density is equal to that of Belgium; but the desert territories of the south have a thin population (546,000 on an area of 850,000 square miles. Cf. "Les Territoires du Sud de l'Algérie," 2 vols., Gouvernement Général de l'Algérie, Algiers, 1922), and the country as a whole could support a much greater number of people. Algiers, the largest town, has over 200,000 people, Oran 146,000, Constantine 78,000. There has been a distinct movement both of natives and Europeans to the towns from the *bled*.

Tunisia, where a census of the native population has been taken for the first time, has a total population of 2,093,939. Tunis, the one large town, has over 200,000.

Much criticism has been made of the census results in Morocco. The difficulties of census taking among the rural population are obvious enough, and there also appear to be discrepancies in the town populations. Thus the census gives Fez only a little over 70,000, when it is generally regarded as a town of 100,000. The figure for Casablanca, 101,690, does not take account of a considerable floating population. Marrakesh, the center of one of the most populous districts, has 102,100. The total native population of the French zone is considered to be not more than 4,500,000—a lower figure than has been credited. For the Spanish zone and Tangiers estimates range from 500,000 to 1,500,000, some authorities attributing to the Rif a much denser population than has been supposed.

The European population of Morocco is estimated at 144,000. The number in the French zone is 62,000 and is almost exclusively urban, half the population residing in Casablanca. The situation is of course different in Algeria, which is administered as an integral part of France, and in Tunisia, both of which countries have been the object of a definite policy of European colonization. Tunisia has 156,000 Europeans, the ratio with the native population being 1 : 13; Algeria has 830,000, the ratio being 1 : 6. These figures, however, are not considered satisfactory, particularly in view of the differential increase of the various races. It is estimated that under normal conditions the annual increment of the French (in origin) population is 3,000; of the other European elements 6,000; of the natives 60,000. The question is whether France can retain her hold over the great and increasing Mohammedan population. The loyalty of this population during the war and the peace in French North Africa is frequently contrasted with conditions among the Mohammedan population of Egypt and India. But with her stakes in the Near East the future is none too sure for France. A widely held view of the need of French West Africa is expressed in the words of a former governor of Algeria: "Si nous ne peuplons pas l'Afrique du Nord, nous ne la conserverons pas"; and by M. Augustin Bernard in his article in the *Annales de Géographie:* "Nul problème à l'heure actuelle n'est plus important pour notre pays que le peuplement français rural de l'Afrique du Nord."

A particularly disturbing feature of the situation is the movement of the European element from the country to the towns. In Tunisia the area of European holdings has suffered a decline of 58,000 hectares from 1914 to 1921; in Algeria land purchases by Europeans during this period have been only slightly in excess of sales.

With her low birth rate France has little population to spare for colonizing. As it is, only about half the colonists are of French origin; Spaniards are particularly numerous in Oran, Maltese and Italians in Constantine and Tunisia. The chief hope of colonization lies in increasing the numbers of these and other European peoples—immigration of the prolific Czechs and Poles is advocated—in spite of a certain danger apprehended in the possible creation of large groups of foreign nationality. Prospective colonists, however, must be assured of land or work; and, if a government program of immigration be initiated, it must be correlated with plans of land development, which in Algeria and Tunisia would especially have reference to water supply for agriculture and in Morocco to means of communication. Some fears also have been expressed regarding the social and political status of the colonist in Algeria since the passage in 1919 of a bill increasing the native franchise and facilitating the admission of natives to French citizenship.

The Aures Massif as a "Cultural Island." In his discussion of the population of French North Africa appearing elsewhere in this number of the *Review* Professor Gautier briefly describes the Aures massif of eastern Algeria (see map, p. 29). An account of ethnographical studies among the people of this "cultural island" forms the subject of a recent book, "Among the Hill-Folk of Algeria" (London, 1921), and articles in the *Geographical Journal* (January, 1922) and the *Scottish Geographical Magazine* (July 15, 1922) by M. W. Hilton-Simpson.

With his wife Captain Hilton-Simpson spent the winters 1912–1913, 1913–1914, and 1919–1920 among the villages of the Aures. Here he found a people living just as they had for centuries past in tiny villages perched in rugged mountain nooks which, though no longer a sufficient protection against modern military invasion, still resist the encroachments of modern civilization because they are so difficult of approach. On every side intervene natural barriers. To the north the watershed of the massif, a wall of steep wooded slopes with peaks rising to some 8000 feet, forms a defense which even the Romans found an effective barrier against invasion. Rome seems to have contented herself with protecting the granaries on the plateau. The extent of the ruins of the Roman camp at Lambèse bear witness to the respect with which the Romans regarded these Berber tribes. To the south a wall of bare rocks deeply incised by the southward-flowing streams presents an implacable face to the Sahara. Eastward the bare ridge of the Jebel Shershar running to an altitude of 5870 feet has successfully withstood invasion from nomad tribes inhabiting the country to the east. The western frontier of the massif is equally impassable, its rugged face being pierced by only one deep defile. So impenetrable are these natural ramparts that not until the French invasion of 1845 was the region actually conquered, and even quite recently bands of outlaws have found an easy shelter in the mountain fastnesses. Islamism has gradually penetrated but by resorting to methods of persuasion instead of force.

It is not surprising, then, that the region is a storehouse of ancient arts, crafts, and customs. Grain is still ground in a twin-stone quern of the type that antiquarians tell us originated in Italy and spread in the wake of the Roman conquest to strangely scattered parts of the earth. Probably Roman too in origin is the water clock used in apportioning irrigation water. Of special interest is the work of the native doctors, their knowledge of materia medica, and their crude yet highly successful surgery, arts which crept into the Aures during the Middle Ages from the Arab practitioners of the time. Far more ancient, however, are many of the arts, that of pottery making, for instance. Several religious ceremonies now practiced as a part of the Islamic ritual also seem to rest on a very ancient basis. Probably more ideas of change and progress have been introduced in the Aures by Shawiya returned from French service during the late war than in the past ages as a whole.

A Great Native Market of the Sudan. The Hausa country of Northern Nigeria is well known as the seat of a commercial activity remarkable in a negroid people, dwelling as the Hausa do far from the sea and "pressed in between the boundless wastes of the Sahara and the well-nigh impenetrable forest of the tropical rain belt." Hausa trade, so widespread that it has given rise to one of the major trading languages of Africa, has always had its center on Kano lying on a great north-to-south trade route. From Tripoli this route runs due south to Bornu (Lake Chad) thence to Kano and southward through bush and forest by divers roads to the Guinea coast. When Hausa trade was at its zenith, in the first half of the last century, the southern terminus was Badagri, near the modern port of Lagos. Trade was conducted by caravan and the great rivers crossed at regular ferries operated by local riverine tribes who levied tolls and guaranteed a certain measure of security in the characteristic manner of this form of trading. Basis of the Hausa trade rested largely on the prime need of the forest people for salt. Salt and also beads and silk from Tripoli were bartered for gold dust, kola nuts, slaves, and European goods from the coast.

Kano itself occupies an exceptionally favorable geographical position, but there are several other important markets in the Sudan, most of them, like Kano, situated about the 12th parallel. This parallel is roughly coincident with the intermediate zone between savana and forest; it separates the oil palms of the latter from the *borassus* and *hyphaene* palms of the former; it marks the southern limit of the date palm. One such important market is Jega which rose into prominence some hundred years ago. It lies southwest of Sokoto on a perennially navigable tributary of the Niger. Three or four days' march away are the productive salt mines of Dallol Fogha on the Dahomey border. Jega also acts as market for the salt of Bilma, southwest of Tibesti, which comes via Agades. It seems worth while quoting a part of Mr. E. W. Bovill's interesting description of Jega market (*Journ. African Soc.*, Vol. 22, 1922, pp. 50–60).

"Although the trade of Jega has been dwindling for some years it still occupies a commercial position second only to that of Kano. Its comparatively small population of about 10,000 includes many rich merchants, mostly natives of Lagos and the Gold Coast. On the outskirts of the town is the large market place comprising over four hundred stalls, built of clay with thatched roofs. Two big markets are held weekly, but there is a fair attendance daily except during the rains, when the trade of the whole country is at a standstill. Outside the town is a *zango*, or caravanserai, of over a hundred houses for traders who pay a small fee for a night's lodging, and here one may see all manner of natives, but they are mostly small Hausa traders. The trade in kola nuts continues to flourish, though on a reduced scale, and a good business is done in European trade goods. By far the most important trade is that with Lagos in cattle. The rapid growth of European and Moslem settlements on the coast has created a big demand for meat. The bulk of this trade passes through Jega and thence southward over the Niger at Gendenne. The following figures for the year 1914–1915 show the magnitude of this trade: cattle 83,592, sheep and goats (mostly sheep) 268,492; horses to the number of 3956 were sold in the market during the same period, while the actual weight of goods brought into the market was estimated at 7556 tons."

The importance in the Sudan and Sahara of the ancient and universal trade in salt is further attested in a short note "Tombouctou métropole du sel" in the September, 1922, number of *L'Afrique Française* (pp. 404–405). The writer describes the fête associated with the arrival of the great salt caravan. Twice a year the caravan brings the product of the Taodéni mines, mines that have been worked without interruption since the sixteenth century and show no sign of exhaustion. The prosperity of Timbuktu is described as resting almost exclusively on this salt trade, and thereby depends a political situation of interest to the French military authorities—but that is another story.

HUMAN GEOGRAPHY

The World's Coal Markets. One of the most interesting chapters in Professor Fernand Maurette's little book "Les grands marchés des matières premières" (Collection Armand Colin, Paris, 1922) is the first, entitled "Les marchés de la houille."

Among the essential commodities coal occupies first place. A coal shortage makes itself felt not only in the universal use of coal as the most important of combustibles but in the chemical industries, to which coal furnishes a steadily increasing number of by-products, and in the metallurgical industries, where coke is of scarcely less importance in the blast furnace than the metal itself. The yearly consumption of coal steadily grows. From 10 million tons in 1800 the yearly demand had reached 1420 millions in 1913. Previous to the war the coal-marketing countries of the world of primary importance were two—the United Kingdom and Germany; and the markets were the Tyne, the Bristol Channel, and the Ruhr. In view of the enormous and universal consumption of coal this limited number of markets is surprising. Several factors have combined to bring it about. To have an excess of coal is not sufficient. The coal must have certain qualities demanded by the clientele. It must be favorably located with regard to cheap transportation facilities. Sufficient carriers must be at hand to convey the product; and, most important perhaps, the country which furnishes the coal must be able to consume, and the purchasing country to supply, some return commodity.

The United Kingdom, and Germany to a lesser degree before the war at any rate, were able to conform to these demands. The United Kingdom consumed raw material from the whole world and sent her coal to all parts of the earth. In Europe she found it necessary to share this monopoly with Germany; but elsewhere competition was negligible. America, in spite of the fact that her 1913 production of 550 million tons exceeded the total production of the United Kingdom, Germany, and France, was not a rival even in the western hemisphere because her own industries consumed all but 20 million tons of that year's production, and three-fourths of that was anthracite for Canada. Added to this the United States had not begun to develop her facilities for shipping coal abroad. Her coal fields were far from seaports, her means of transportation to the coast limited, her merchant marine a negligible quantity. In 1913, of the coal purchased in the Argentine Republic, only 2 per cent came from the United States while the United Kingdom furnished 98 per cent. Of Brazilian consumption 25 per cent was American coal and the remainder British. The United States stood, therefore, among the secondary coal markets of the world, to which belong Japan, Tonking, and India with their limited local trade; Australia with her trade with the Pacific islands and the west coast of South America; and South Africa, whose trade was also local.

In 1913 Great Britain produced 287 million tons of coal, of which 74.5 millions were exported. Of the exported coal Cardiff, the port of the Welsh fields, furnished 27 million tons; while Newcastle, the port of the Northumbrian field, furnished 24 million—a total of over 68 per cent of the entire exportation. Each of these fields supplied a distinct clientele. Newcastle sent her coal to the Baltic, Russia, Scandinavia, Germany (certain qualities), the Netherlands, and Northern France as far as the Channel. Here commenced the Cardiff zone. To Cardiff and the other Welsh ports belonged the rest of the world—western and central France, Portugal, Spain, the entire Mediterranean, West Africa, South America, and the shores of the Indian Ocean. Germany, whose coal resources in 1913 were estimated at 80 billion tons, possesses like England the advantage of an easy means of transportation by water routes, her principal exporting field lying close to the Rhine. In 1913, 191 million tons were produced, which, together with 10 million of imported British coal, left 45,000,000 for export. The entire Saar output went to Alsace-Lorraine; that of Upper Silesia to the Berlin region; that of Vistula to Poland and Austria. The foreign market depended chiefly upon the Ruhr fields. In 1913 the port of Duisburg exported over 14,000,000 tons, of which about equal amounts went up and down the Rhine. That going downstream went to the Netherlands, Scandinavia, and Russia. The upstream cargoes were for Switzerland, northern Italy, and France, where at Lyons and Paris they met British coal.

Since the war the whole aspect of the world's coal markets has changed. Germany finds her coal fields much curtailed by the treaty of peace, but her loss of territory has also diminished her consumption. It is possible, however, that the Ruhr fields will return eventually to their old place in the world market. England finds her yearly output cut down, in spite of increases in personnel, by the shorter hours and smaller hourly production. Her exportations dropped from 74.5 million tons in 1913 to 38 million in 1920; and of this 92 per cent went to European markets. She no longer supplies the world market that was hers before the war. Increased cost of production—nearly double—and transportation has weakened her ability to compete with local supplies. South African and Australian markets are rapidly becoming more than local. Australian coal has recently sold in Sweden for less than Newcastle coal.

In the meantime, impelled by the necessities of war, the United States has come quickly to the forefront as an exporter of coal. Distance of coal fields from seaports has been largely counterbalanced by efficiency of transportation to seaports and by port facilities. Her merchant marine is more than adequate for some time to come. Her production of coal was 640 million tons in 1920—50 per cent of the world's production. Certain mines specialize in the production of coal for export—some fifteen in Pennsylvania, Maryland, and West Virginia being worked entirely for that purpose. In the Hampton Roads region wharves with the most efficient of loading equipment, adopted from the Great Lakes ports, have been built. American coal is still to be found in Mediterranean markets but in steadily decreasing amounts. The export field for American coal probably does not lie in Europe; but a great field is open in South America and the Pacific where ships can find much raw material with which to fill their holds on the return voyage. Argentine consumption of American coal increased from 2 per cent to 46.2 per cent from 1913 to 1917 with a slight decrease since. Brazil used 78 per cent of American coal in 1917 against 25 per cent in 1913. The great coal marts of the world are no longer confined to the Tyne, the Bristol Channel, and the Ruhr. To them has been added Hampton Roads.

HISTORY OF GEOGRAPHY

Physical Geography at the Court of the Emperor Frederick II. The Sicilian Court of that original genius, the Emperor Frederick II (1212–1250 A. D.), was one of the rare spots where during the Christian Middle Ages a genuine interest in science was fostered. Frederick used what we now believe to be essentially modern methods of research—observation, experiment, and the questionnaire. Professor C. H. Haskins in an important article on "Science at the Court of the Emperor Frederick II" (*Amer. Hist. Rev.*, Vol. 27, 1922, pp. 669–694; reference on p. 688) tells us that "Frederick, not long before 1242, sent a series of questions to be answered by Mohammedan philosophers in Egypt, Syria, Irak, Asia Minor, and Yemen, and later to the Almohad caliph of Morocco, ar-Rashid." The text of another of these questionnaires, in which the Emperor propounded to his court astrologer, Michael Scot, some searching inquiries into matters of cosmology and physical geography, has recently been published in another article by Professor Haskins (C. H. Haskins: Michael Scot and Frederick II, *Isis*, Vol. 4, 1921, pp. 250–275, Brussels. A translation of the questionnaire will be found in Professor Haskins's article first cited, pp. 689–691). Frederick craved to learn many things: the location of the abyss, of hell, of purgatory, of paradise; why the sea is salt; and the causes of hot springs, volcanoes, and other natural phenomena. It is interesting to note that in the midst of his doubts and perplexities, of one fact Frederick was sure. "For we greatly wonder at these things," he says, "knowing already that all waters come from the sea and passing through divers lands and cavities return to the sea, which is the bed and receptacle of all running waters." Michael Scot's reply contains much typical geographical lore of the Middle Ages. Particularly noteworthy is the description of the hot springs, volcanoes, and sulphur beds of Italy, Sicily, and the Lipari Isles, the text of which is given by Professor Haskins (*Isis*, *loc. cit.*, pp. 272–274). If Michael's "knowledge of the Lipari group does not necessarily rest on personal observation, it at least represents inquiry among those who have observed. Although the omission of any special account of Etna is noteworthy, he has in these local matters gone well beyond Aristotle's *Meteorology* [the source of most of the meteorology, vulcanology, and seismology of the Middle Ages] and given some real description of volcanic phenomena." Michael mentions especially "Strongulus" (Stromboli), "Strongulinus" (Strombolicchio?), "Vulcanus" (Vulcano), "Vulcaninus" (Vulcanello?), "Moncibellus" (Etna), and "insula Lipari" (the island of Lipari), "in which are all kinds of fine trees and grains." Stromboli, he says, is a great mountain in the midst of the sea, which constantly emits flames. Flames also spring from Vulcano, Vulcanello, Etna, and the island of Lipari, but only when the south wind (*auster*) blows. When the flames cease, mighty smoke pours forth. Michael's detailed comments on the volcanic *ejecta*, the pumice strewn far and wide over the surface of the sea, and on the manner in which it is gathered by the people for use as a building material, and finally on the manner of obtaining sulphur from the sea's surface—all reveal more than book knowledge of these regions. In his discussion of the causes of vulcanism and of thermal springs, on the other hand, Michael confusedly follows and enlarges upon classical models. Briefly stated, he believed that these phenomena are due to wind penetrating into the cavities of the earth and there coming in contact with sulphur and other burning stones (*petrae calidissimae*). A great mercy of God it is, he adds, that this sulphur and these stones are hidden away far beneath the surface, for otherwise the winds blowing over them would destroy the world with their heat.

GEOGRAPHICAL NEWS

OBITUARY

HENRY VIGNAUD. Henry Vignaud died at his home in Bagneux, Seine, France, September 18, having all but reached his ninety-second birthday.

Among the keenly critical students of early New World discoveries Mr. Vignaud held preëminently the leadership, being justly entitled to be called, in his last years, "The Prince of Americanists," which term he had once graciously employed to characterize his long time friend Mr. Henry Harrisse, but a friend with whose conclusions he did not at all times agree.

His had been an exceedingly active and useful life. To his native state, Louisiana, he was a loyal son, first attracting attention to himself as a newspaper correspondent and editor and, in the earlier months of the Civil War, as Captain of a Louisiana Regiment. His abilities brought to him an appointment as Secretary of the Confederate Diplomatic Commission to Paris in the year 1863, and practically all the remaining years of his life were spent in Europe, with but occasional interruptions, at Paris. In the Diplomatic Service of his country after the war was over he achieved very notable distinction, serving at times as a member of commissions and of important conferences, being appointed in the year 1875 Secretary of the American Legation in France, an office he filled most acceptably for thirty-four years. In 1909 he was retired but continued to hold until his death the title Honorary Counsellor of the Legation. The last two decades of his life were by far his most fruitful within the literary field, in which years he won for himself a very enviable international reputation. The list of his publications is a long one—books, pamphlets, articles for the more prominent periodicals representing the field in which he was so greatly interested, especially for the Journal of the Société des Américanistes, which Society he served many years as president.

Mr. Vignaud was a keen critic who delved deeply into the contemporary records of the period which claimed his interest, and not a few of the long accepted but not well authenticated beliefs concerning Christopher Columbus he so successfully attacked as to warrant the emphatic statement that the older biographies of the admiral must either be discarded or rewritten.

It is but the briefest reference to his position that can here be made. Let it be noted that a very respectful hearing was accorded him for his first important work, "Toscanelli and Columbus," wherein he contended, with arguments most elaborately supported, that there never was a Toscanelli letter nor a Toscanelli map such as practically all Columbus' biographers have been inclined to accept. In a letter to the author of this brief note which was received but shortly before his death he expressed himself as not feeling inclined to give further consideration to the Toscanelli question, since we now know so well the purposes and plans of Columbus before he sailed. These did not include a search for a westward route to the Indies, but as is so clearly set down in the Capitulations signed by the Queen, the King, and Columbus himself on the eve of his departure, it was to find "islands and mainland"; and these he found, the greater glory being his for so doing. It stands to Mr. Vignaud's credit to have found in contemporary documents convincing testimony that Christopher Columbus was not born in the year 1436 nor in 1441 but in 1451; that he was never a student at the university of Pavia; that there was no other distinguished admiral in his family; that his so-called scientific theories were formulated after his discovery of the year 1492 and not before; that we have a decidedly prejudiced account of his life in the biography attributed to his son Ferdinand and in the biographical record left by Las Casas.

Among Vignaud's more exhaustive studies, in addition to his "Toscanelli and Columbus," we have his "Histoire critique de la grande entreprise de Christophe Colomb" in two sumptuous volumes, and his "Améric Vespuce." During the last years of his life he was engaged in the preparation of a work of considerable magnitude which he called "Les sources cartographiques imprimées de l'histoire de la géographie." He worked with the enthusiasm of youth to the last "with a clear vision," as he said, but with a frequently expressed doubt that he would be spared to complete the task he had set himself. This work he left in manuscript.

E. L. Stevenson

NOTE

M. le Commandant Ch. Gorceix has called the writer's attention to an error in his note on the Abyss of Cap-Breton in the July, 1922, number of the *Geographical Review* (p. 501). M. Gorceix regards the abyss as probably the result of solution of gypsum or rock salt, but the idea that the solution has been accomplished by "a subterranean river" was only quoted from other sources and not adopted by him.

W. M. Davis

GEOGRAPHICAL REVIEWS

On Human Geography

P. Vidal de la Blache. **Principes de géographie humaine publiés d'après les manuscrits de l'auteur par Emmanuel de Martonne.** vii and 327 pp.; maps, indexes. Librairie Armand Colin, Paris, 1922. 25 fr. 10 x 6½ inches.

Paul Vidal de la Blache died in 1918. At the time of his death several of the chapters of this work had appeared in the *Annales de Géographie* for 1917 and 1918; but the greater part was still in manuscript and some of it in fragments. The preparation of the whole for publication in book form fell to M. de Martonne of the Sorbonne, Vidal's former pupil and one of his successors. M. de Martonne explains in the preface that Vidal would have been far from satisfied with the work as it stands, unfinished. Publication, none the less, was eminently worth while. In spite of incompleteness and imperfections, "Principes de géographie humaine" expresses the fully matured thought of one who for many years was the leader and inspiration of that French school which is doing more, perhaps, than any other group to establish human geography upon a sound and scientific footing.

Human geography, as Vidal interprets it in his short introduction on the "meaning and purpose of human geography," goes far beyond mere objective description of countries and peoples. It grows from "a new conception of the relations between the earth and man, a conception suggested by a more synthetic understanding of the physical laws which govern our terrestrial sphere and of the living beings which inhabit it." Underlain by the notion of the unity of nature and of the interlocking connections of terrestrial phenomena, its purpose is to reveal man's relation to that complex of inorganic and organic elements which in any given area constitute environment and to determine, but never to exaggerate, the influences of environment on men "which do not show except through the veil of historical contingencies." Human geography owes its very existence to advances that have been made during recent years in the natural and human sciences. An especial debt does it owe to ethnography and primitive archeology, for primitive folk are more directly and obviously seen in relation to their environment than peoples of higher development. Not less is its debt to progress in our knowledge of the fundamental facts of the distribution, density, and composition of population. Human geography must take cognizance not only of man as passively adapting himself to environmental influences but also and even more emphatically of man as a "geographical factor" himself, capable of exerting profound modifications upon the face of an ever changing earth.

The main body of the book is divided into three parts, each of which is a unit in itself. Part I, devoted to the distribution of population over the globe, includes the chapters which appeared in the *Annales de Géographie* and was summarized in some detail in the *Geographical Review*, Vol. 7, 1919, pp. 52–53.

Part II, on "forms of civilization," is the most original portion of the book and bears most clearly upon it the stamp of the writer's genius for close reasoning and precise generalization. Here are analyzed the relations between the geographical factor in man's environment and various products of human activity: material and tangible objects, such as tools, clothing, arms, building materials, villages, cities; intangible concepts, such as the evolution of civilization and progress.

To illustrate Vidal's treatment of the material side we may refer to the discussion of "établissements humains." As used by the French geographers, this phrase, for which we have no precisely corresponding term in English, denotes those structures built by man to house himself and his property. They may be either for permanent or for temporary occupation and either isolated or in groups, whether tents, huts, cottages, houses, barns, factories, storehouses, or farms, hamlets, villages, towns, metropolitan agglomerations.

The problem of sites is one of immense complexity, especially where settlement has been long established, as in Europe. Historical causes and the intricate conditions of human occupation there have often completely modified and obscured the effects of natural influences. A general rule, nevertheless, may be formulated: that "human establishments" show a tendency to spring up at points where access is most easily available at one and the same time to the greatest possible number of elements, such as water, soils, pasturage, woodland, vineyards, etc. These points are frequently found along the well defined lines of contact of different geological formations, a circumstance which explains the phenomenon of "villages in series" common in some parts of Europe. The influence of commercial routes is far less potent, and the rural community of Europe as often as not centers around villages standing apart from the highways.

The grouping of rural habitations is characterized either by dispersal or agglomeration. The dispersed habitat is found where there is pronounced diffusion of waters and where there is diversity in the orientation of slopes and in the nature of soils over limited areas. Brittany with variegated surface pattern and scattered hamlets and dwellings is a typical region of dispersal. Dispersal also usually prevails among mountains. The agglomerated habitat—in other words the compact village—is not only found along the lines of contact of geological formations or of other features of the terrain but also is eminently characteristic of broad plains of uniform soil and relief, where economy is attained through cultivation on a large scale together with the centralization of labor, tools, water, granaries, and all that is incidental to the exploitation of the fields. The agglomerated village occurs in many parts of Europe but is preëminently typical of the plains of China and of India.

Vidal de la Blache makes some striking comparisons between the position held by the village organism in relation to society as a whole in India and China on the one hand and in Europe and America on the other. The village of the Far East is the essential social unit, "absorbing a strong part of the social life to the detriment of the vaster organizations of the city or state." In Europe under modern industrial conditions this is no longer so: the influence of the city over rural life is becoming ever more powerful. In America, Vidal asserts, urban influence is supreme; the village stage of social development has been virtually skipped, and, except in the older parts of the country, the village essentially does not exist at all. "The actual means of circulation, the creation of *entrepôts* provided with all kinds of merchandise and the custom of transforming agricultural products into bank credits, take away from the village much of its *raison d'être.* It is to the city, even to the very large city, that rural groups turn. The city controls the relations between rural peoples."

After passing in review the material products of human activity in their geographical relations, Vidal undertakes the more ambitious task of explaining the geographic elements in the evolution of civilization and of progress.

There are two opposing tendencies in mankind, he says. One of these is "a natural tendency toward perfection." Revealing itself even among the most primitive folk this is a force of will, a creative and artistic impulse that urges man to exert ingenuity and skill, to make himself the master of his surroundings and of the materials with which he works. If all progress springs from this impulse, it is ever opposed by the second tendency, the tendency toward stagnation due in part to natural indolence and in part to the erection of artificial prejudices against all that is new. In some regions the first of these tendencies has prevailed, and development has been more or less continuous. Elsewhere, after reaching a certain point, development has been arrested, and life has become stereotyped, governed by archaic forms and customs. Vidal de la Blache seeks for a geographical explanation of the reasons why some regions have favored progress.

If we interpret his meaning rightly, progress springs largely from the interchange of ideas and customs; where geographical conditions have encouraged a maximum of such interchange and intercommunication, progress has been most rapid. Isolation and stagnation are almost synonymous. But mere contact between two civilizations, one static and one advancing, rarely is capable of producing any radical alteration in the life of either. Invasion has seldom greatly modified the habits of the conquered, and China and India have shown themselves proof against fundamental changes brought through the extension to their shores of the maritime commerce of the Western nations. Japan's absorption of Occidental manners is superficial rather than fundamental.

Strong civilizations, Vidal believes, grow from the merging and amalgamation of many previous civilizations. The Mediterranean culture of the Roman Empire was built from a combination of Greek, Etruscan, Phoenician, and other elements; and each of these from a series of earlier combinations. If the origins of civilizations be sought for, they will be found in diverse nodal points; and the more numerous and variegated these be, the richer and more progressive the civilization arisen from them. The geographical features of the

Mediterranean basin and of Europe have been more favorable than any other part of the world to such progress. "Neither the great river valleys deep in alluvial soil, nor the living waters of the Mediterranean, nor the rich plains of the Danube or of southern Russia suffice by themselves alone to explain the persistence under divers forms of progressive civilizations. But the distribution of seas and lands, the interspersal of plains and mountains, the contiguity of steppes and forests have made it possible for geographic causes here better than elsewhere to combine in their effects. . . . European civilization has been nourished in its origins at a multitude of distinct hearthsides, has absorbed the substance of a large number of local *milieux*. From these antecedents, from this elaboration that has progressed through centuries, mutual connections have been actively maintained, and European civilization has drawn its richness and its fecundity."

The third part of "Principes de géographie humaine" is devoted to the analysis of an aspect of human enterprise which lends itself readily to geographical treatment: circulation and transportation. One cannot fail to detect a difference in character between this portion of the book and the preceding parts: the treatment is more descriptive and empirical, the thought less close, the scope of ideas less ambitiously framed, and the generalizations perhaps a shade less penetrating. Possibly this arises from the more obvious nature of the subject, but we believe rather that it was due to the intervention of death before Vidal could bring this part of the work to the fully matured stage of development attained in the earlier parts. In Part III we are led in logical order from the survey of the geographical relations of the simplest and most archaic modes and routes of transport and circulation to that of the most complex and highly organized, from the consideration of man himself as a beast of burden to that of the railway and steamship. Striking observations are made in regard to the influence of railways on the opening up of hitherto undeveloped regions—the Middle West, Canada, Argentina, Australia, New Zealand, to the changes in the distribution and density of population that have resulted therefrom, and to the immense influences of maritime navigation. The idea is constantly kept before us of the development of transport as an active geographical factor, as a force which has tended ever to mold anew the human geography not only of regions and of continents but in later years of the entire world.

No longer do we try to explain the infinitely complex story of mankind in simple terms. Leadership or social conflict, religion or the quest for food, intellectual force or environment—no one of these is sufficient. If some of the details of historical events lend themselves to proof, the interpretation of these details, the very soul of history, assuredly does not. Here all that gives us confidence in a man's work are openmindedness, the power of wise and fair selection, and that sublimated common sense sometimes known as the critical spirit. Vidal de la Blache's great contribution to human geography was to bring to it these qualities of historical mindedness and to show that they are the essentials of geographical mindedness as well. Their lack among its devotees has been one of the obstacles to the development of human geography. This is what Lucien Febvre in his "La terre et l'évolution humaine," reviewed below, constantly brings up against Ratzel and his disciples. In their enthusiasm to explain the influences of environment they have been blinded to the recognition of all other influences. Vidal de la Blache is one of the few geographers to whose work Febvre gives well-nigh unstinted praise.

It is enlightening to compare the two books of Febvre and of Vidal, which happened to appear at about the same time. Both show great erudition, both are keenly critical, both warn against the evils of generalization built upon insufficient facts or upon the faulty interpretation of too abundant facts. Where Febvre directly and aggressively pulls to shreds the arguments and assumptions of Ratzel and others with whom he disagrees, Vidal accomplishes the same thing by more subtle and less pugnacious means, setting forth the positive and constructive results of his own research and thought. Where Febvre oppresses with a stifling sense of the difficulties and dangers that beset the man who dares to venture upon the quicksands of human geography, Vidal with the pen of a genuine artist stimulates the reader to follow him in the study of a difficult but alluring subject. Where Febvre, without expressly denying that it exists, leads us to despair ever of finding the geographical element and its influence upon human life, Vidal with sure and delicate touch unweaves what is geographical from the tangled skein of other influences. If Febvre's book is admirable as a corrective to looseness and hastiness of thought, Vidal's is all of this and much more besides—a great, constructive, and permanent contribution to science and to literature.

LUCIEN FEBVRE. **La terre et l'évolution humaine: Introduction géographique à l'histoire.** xxvi and 471 pp.; maps, bibliogr., index. (L'Évolution de l'Humanité, Vol. 4.) La Renaissance du Livre, Paris, 1922. 15 fr. 8 x 5½ inches.

A geographic introduction to history ought to help one to read history. This is rather a warning that geography has not yet much that is sound to offer and that a great amount offered is unsound. "In reality we only know trifling details of the influence of geographic environment on human societies: the geography which should describe that influence is barely beginning to be born and established." Ratzel's work is too ambitious in the assumption that his erudition suffices for the examination of the world; but, vast as was Ratzel's erudition, it did not begin to meet the need. We need years and years of patient studies of limited regions such as a good many Germans and a small group of Frenchmen, under the inspiration of Vidal de la Blache, have been making, to prepare a suitable body of observed facts on which to generalize. Perhaps it is natural that Febvre should overemphasize the work of his countrymen. Ratzel's concept of the essential vitality of a state in its "desire, hope, and constant appetite for expansion" is fairly criticized as not geographic but German.

Good service is done in demanding critical thought. It is not worth while to describe landscapes and climates in the first chapter of a history and then never revert to the subject again as Duruy and Curtius have done in writing histories of Rome and Greece. To offer to tell what a people is like if told what their environment is, as Michelet has done, is mere rhetoric. It is futile to hope for enlightenment from vague generalizations about Man, Nature, and Influence. That is the fault here found with Ratzel and his disciples, especially Miss Semple. I might interject that precisely the unsound, or unbased and inaccurate, generalizations of which the apostles of Projects in Geography are most fond, are anathema to Febvre. "'Hunting and fishing,' writes Montesquieu in Chapter IX (Du terrain de l'Amérique), increase men's stores to plenty.' They complete thus the work of 'nature, which produces spontaneously many a fruit for man's nourishment.'" Febvre comments: "Simple ideas, simple actions, unprecise generalities" (p. 110). Perhaps a reader well versed in geographic influences will wonder what he would have Montesquieu say. Were there not abundant natural fruits, and did not hunting and fishing add most acceptably to the resources of the American pioneers? That, Febvre seems to think, depends on the men! Nature nourishes and especially gives liquid to satisfy thirst to Australian blacks in the same environment where she lets a European die of thirst. Stefansson ("The Friendly Arctic," p. 323) tells us game is abundant and easily available on the spot where Sir John Franklin and his men starved [my illustrations]. Nature limits herself strictly to offering opportunity. She nourishes no one. She makes no one do anything; she gives men a chance. Men, according to their habits, overlook the chance or accept it in full or in part. We should follow Vidal de la Blache in studying *the relations between actual human societies and their environment.* This Febvre contrasts with Influence of Nature, in capital letters. That is the keynote of the book if it has one. Nature exerts no influences at all! Also Febvre wants to bring out here the neglected action of man on nature.

Miss Semple, he says (p. 205), expresses "with enthusiastic faith" the views he combats. She cites the narrow negro-inhabited region south of the Sahara as of little variety of relief or climate and of monotonous development, rudimentary agriculture and lowest forms of pastoral life making it a unit region in its monotony. "Do not object that the picture is too crude; that it rests on a very superficial knowledge of the physical and human geography of a country which the explorers, more and more, are representing as extremely varied in its productions, extremely rich in its possibilities, all made up of regions quite differentiated, and all peopled by a veritable marquetry of tribes of utterly different origin. Do not object, for it is useless making objections to a believer armed with a dogma that may not be discussed."

Of course Febvre pays his respects to the time-honored doctrine that humanity has passed through three stages of culture: the hunting and fishing stage, the grazing-nomadic stage, and the agricultural stage. Wasn't that a regular and normal succession, in all probability? Haven't all peoples come through the three in that order? These were culture stages, too; of savage hunters, semicivilized nomads, and civilized agriculturists! Febvre thinks Mortillet in 1890 the last serious observer to be convinced of this old theory. Its defects began to be evident thirty years ago. For observations of fact were multiplied, and it became evident that it was hard to find "pure" stages. Actual peoples, wherever observed, have done more or less all of these things at the same time. Other stages, too, are proposed by observers, for such peoples as collect fruits and roots and have no tools and fall into none of the three classes. It has become clear that there is no necessary passage between stages in the traditional order and that links may be missing in the chain, as in Mexico and Peru, where the agricultural people of pre-Conquest days had never been pastoral. It is clear that two of these distinct stages do coexist today in one people at the same time, as when a fisher Indian has a wife who collects berries and roots. Roscher pointed out in 1903 that either hunting or grazing or agriculture may be the earliest stage, according to accidents of place or climate. Nowacki in 1885 undertook to prove that the first tillers of the soil had no animals and used only a hoe, coming later to acquire horse and cow without passing through a nomad stage at all. Hahn in 1896 (Edward Hahn: Demeter und Baubo, Versuch einer Theorie der Entstehung unseres Ackerbaus, Lübeck, 1897) proposed the scheme: (1) use of the hoe in agriculture (millet-raising among the lake dwellers); (2) taming of the ox, first as a sacred animal, later for use; (3) use of cattle and horses and nomad life; (4) invention of the wagon—first sacred, drawn by the sacred ox; then the plow drawn by the ox for use; (5) modern type of agriculture. However satisfactory or unsatisfactory this may be, it is good procedure as an attempt to meet actual facts of observation. It is not authoritative, but improvable where reason can be shown. Furthermore, careful observations do not show nomads to be inferior to agriculturists, nor the other inferiorities demanded by the old theory. The stages discussed were stages of food-getting, not stages of culture. Culture was mere assumption, like the time order of the stages themselves. As a matter of fact it appears more probable that habits are the *cause* of the method of food-getting adopted by a people than a result of the way nature thrusts food upon them! A remarkable case is that of the pygmy hunters living permanently alongside the agricultural negroes of central Africa (p. 302); the pygmies raising no vegetable crop, the negroes hunting no game but exchanging their vegetables with the pygmies for meat. Yet the two peoples live side by side in the same environment, their villages intermingling. Habit, not environment, gives each its occupation.

Of course Febvre is fallible. He thinks an arrow would hardly kill game, unless poisoned. The North American Indians certainly killed the bison with bow and arrow: or is that another myth?

There is much that is suggestive in the criticism of theories of culture stages. The Arab, supposed to draw from his desert home the imagination that inspired the Koran, is accused of borrowing the plan of the Koran from the Jews. Never in historic time, says Febvre, have any nomads been able to support themselves by their flocks alone. Always their main food has been grain, which they obtained from their sedentary neighbors. The nomad is merely the wanderer—the word Kirghiz, for instance, is said to mean only that—the man driven away from the good land, the agricultural land, by his enemies whom he therefore hates and envies for their possessions.

Enough has been said to give an idea of the book. The author has read much, especially French writings, and has tried to criticize. His style is somewhat confusing; he resorts to veiled irony that, to the English reader, is not always clear. If he wished to help geographers, he would have done better to have selected from all he has read that which he regards as sound. Probably this would have contained a great deal of material drawn from Vidal de la Blache.

MARK JEFFERSON

HIGH ALTITUDE POPULATION DISTRIBUTION IN SWITZERLAND

H. DE MONTBAS. **Le peuplement des Alpes Suisses: Sa répartition et ses limites d'altitude.** Map. *Mémoires Soc. Fribourgeoise des Sci. Nat.*, Vol. 8, 1919, pp. 155–240.

The two main questions considered in this discussion are: "What is actually the distribution of the inhabited centers of the high mountains in the Swiss Alps?" and, "What conditions formerly determined their creation and still govern today the development or decadence of these centers?"

The author first takes up the study which presents the actual distribution in Switzerland of the inhabited places situated at or above an altitude of 1000 meters—a contour line corresponding to a well-defined geographic and climatic unit—and then passes on to the discussion of the most characteristic cantons from this viewpoint.

The population density of the Alpine zone per square kilometer is scanty and unequally distributed. The census of 1900 shows 315 communes whose principal agglomeration is found at an altitude of over 1000 meters. These represent about one-tenth of the total of Swiss communes, but their territorial extent includes more than one-half of the surface of the country. These 315 communes have a total population of about 200,000, a little more than five per cent of the Swiss population.

Among the Alpine cantons (Grisons, Valais, Bern) having the largest number of inhabitants above 1000 meters, the Grisons holds first place. Its area is 7113 square kilometers, of which 3500 are given over to agriculture and 1438 to forests. 30.5 per cent of the total is unproductive, showing the presence of high massifs and glaciers. The population has increased more than ten per cent between 1900 and 1910. The average density is 15 inhabitants per square kilometer, or 25 per productive area. Of the total population 54 per cent lives above 1000 meters; of which 14 per cent lives between 1500 and 1800 meters and 4 per cent above 1800 meters. In no other place in Switzerland or even Europe, except a few in Valais, do we find centers of permanent habitation as high (reaching 2100 meters in Avers). Temporary huts or settlements are found on the highest snow limits; pastures are generally found at 2400–2500 meters and sometimes, for sheep only, at 2700 meters.

It is because these high mountains are accessible that we see villages forming at an altitude of 1500 meters or more. It is because they are generally poor and barren that the inhabitant has to resign himself to live on little, to substitute for an intensive and remunerative culture an extensive exploitation of land merely for pasturage.

Climate, precipitation, floods, hostile neighbors, and human caprice are some of the factors that enter into the establishment of settlements. The creation of artificial centers, such as inns and hotels, and the development of roads and railways add still more to the development of the heights. It is these last factors that have contributed most largely to a considerable increase of population in many mountain communes, notably in canton Grisons.

A number of tables showing heights, the increase and decrease of population, and the communes in Switzerland above 1000 meters are found throughout the article. A relief map (1 : 600,000) shows the distribution of the inhabited centers in the Alpine mountain cantons above the 1000-meter line. It indicates the highest pasturages, the principal passes and roads, and the places that have had a notable increase between 1900 and 1910.

Hélène Neumann

A Popular History of the Roads of France

Jean Bonnerot. **Les routes de France.** iv and 167 pp.; maps, ills. Les Évocations Françaises, H. Laurens, Paris, 1921. 10 x 7 inches.

This book, with its many and attractive illustrations, is a popular history of the roads of France and of their relation to the life and development of the French nation. It is a very flowery book indeed, full of brilliant color and Gallic rhetoric. Its avowedly popular and rhapsodic character may explain, but does not altogether justify, a tendency toward sweeping generalization. It is obvious that routes have an important influence in determining the sites of battlefields, but it is misleading to state, as the writer does on page 72, that "La France est peut-être le seul pays où la route ait toujours determiné l'histoire et marqué par avance les lieux de ses victoires et de ses défaites." M. Bonnerot often seems to get the cart before the horse by attributing to the roads the power of bringing about political, social, and other effects which in reality merely find their reflection in the highways. Figures of speech, perhaps; but figures of speech are often treacherous.

The book, none the less, is a worthy contribution to the literature of travel as a form of human enterprise (see *Geogr. Rev.*, Vol. 11, p. 628), not only from the stylistic point of view but because we find in it a fresh grouping of facts. There is distinct geographical value in a broad sketch of the history of travel and communication of a European region from the days of paths hacked through the forest by the stone axes of cave man and lacustrine dweller to this present age of railroads and automobiles.

During epochs of strong and stable government the routes of France were well kept up, and communication generally was easy and uninterrupted. The Roman roads, built in the main for political and military purposes, with their massive structure and undeviating course across country, were symbols of Roman rule and fell into disrepair and disuse only when the Middle Ages brought about the political and social shattering of the country.

In the medieval period far poorer roads took the place of the Roman highways, but these were enlivened by new types of wanderers: crusaders bound to the Holy Land, pilgrims to the shrine of St. James of Compostella, merchants to the fairs of Champagne or Flanders. The turbulence of the Hundred Years' War and Wars of Religion made itself felt in insecurity of life and desperate difficulties of travel, but as the nation gradually emerged, a strong and unified monarchy at the close of the sixteenth century, the administration of the main lines of communication was taken over by the crown. Sully, the great minister of Henry IV, was made "Grand Voyer de France;" Richelieu instituted the public post; Colbert undertook road building on an immense scale with the aid of the *corvée*, or obligatory employment of peasant labor. The Corps of Bridges and Roads, organized in 1713–1716, was the main factor in building and improving that great network of highways, successor of the Roman network, which is the pride of modern France. M. Bonnerot's portrayal of life on the royal roads and of travel by diligence is the most lively and entertaining part of his book. The abandonment of the roadways which resulted from the building of railways was temporary. With the age of motor transport the great highways of France have once more come into their own. Heroic was the part they played in the World War. Indeed a new era of highway construction is now opening with the building of tourist automobile routes through the Alps, along the Riviera, and in the Pyrenees.

Economic Psychology of the Spaniard

Alfred Rühl. **Die Wirtschaftspsychologie des Spaniers.** *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1922, No. 3–4, pp. 81–115.

With this short paper Dr. Rühl has opened a new field of the utmost importance to geography, the economic *ethos*, or standard of a nation. The paper is most illuminating. A certain complication comes in, however, for an American reader, since not merely its language is German, but the author's economic ethos too is German. Hence the picture of Spanish feeling in economic matters is obscured by a veil of German feeling. For example take the author's comments on the admirable inner democracy of Spain, the complete lack of real caste spirit: "In the street railway a high officer chats the whole trip with a workman sitting beside him." "House steps that were only for masters (Herrschaften) would be quite unintelligible to Spaniards." The American feeling in these matters is certainly not that of the German and probably not quite that of the Spaniard.

In general many good observers through a number of centuries have found the Spaniard to be intensely miserable. Setting aside the past here are a few touches of the present: "More than half the people can neither read nor write. Almost nothing is known to them of other countries. They are behind the world in agriculture and industry. They get no proper returns from the soil, no fair share in the wealth that foreigners take out of the country. Though the winters are usually cold, they have no means of warming their houses. In all the central and north-central part of the land a bed is a luxury. Most of the country people sleep in their barns, if they have them, on the straw, with all their clothes on, covering themselves for a blanket with what serves them as cloak by day. Their clothes are never taken off until discarded because they can be mended no more. Wages are 30 to 40 cents a day except in harvest time, when they may rise to $1.40. Their food is bread, a little of some vegetable, olive oil, and salt fish. Meat is hardly used."

There has been no strenuous industry in Spain since the days of the Moors except among the Basques and Catalans of the north and northeast. When the Moors and the Jews were driven out, Spain lost the men who had given her agriculture, irrigation, and industry; who had brought her the orange, the date, the pomegranate, the almond, sugar cane, cotton, and silkworms; who had planted olive groves and exploited mines; who had inaugurated manufactures that had made Spain significant and famous in world trade. When these men departed no Spaniards took their places, and their work simply ceased to be done.

The keynote of the Spaniard's economic feeling appears to be that he does not regard strenuous exertion as tolerable at any price whatever. Work is rather disgraceful in any case, but very hard work is not to be thought of at all. He has no regret in doing without the things that strenuous work might bring him. Extreme sobriety and moderation are his substitutes for progress. "Don Quixote's advice to Sancho Panza—eat little for dinner and less for supper—is national practice." Measured by the customary standards Spain is backward in almost everything. The Spaniards draw from their land nothing like the wealth that Germans or Englishmen would. They make few things as well as foreigners. Even their own special products they elaborate badly or leave to foreigners to elaborate. They have poor communication and little commerce. They thought Spain a great power until the United States took their colonies away from them. In fact most of their shortcomings are unknown to them.

This is the most interesting aspect of their case and one that Dr. Rühl does not set forth explicitly. The Spaniards are *not aware of their wretchedness.* They think their country a paradise. Apparently nothing can be done for them until they have been shown how miserable is their lot! Such missionary work would be of course well worth while to anyone who can supply the needs he awakens in them!

Furthermore, it is interesting to note how lightly the alarms of the Malthusians pass over the heads of this people. Dr. Pearl showed in the October *Review* that we progressive nations are consuming the world's resources at an intolerable rate. Not so the Spaniard. If he could only get his progressive foreigners out of his country his resources would supply his moderate needs for many another century!

Mark Jefferson

The Sea in the History of Japan

G. A. Ballard. **The Influence of the Sea on the Political History of Japan.** xix and 311 pp.; maps, diagrs., index. John Murray, London, 1921. 18s. 9 x 6 inches.

As Admiral Ballard states in his Preface, the purpose of this work is "to extract [from the different histories of Japan] all matters of political importance on which the maritime situation has produced an effect, and add the comments suggesting themselves to a naval officer." For the adequate fulfillment of such a task, the author's high professional standing and his many years spent in Far Eastern waters qualify him in an altogether exceptional degree; while the fact of his birth in India may account in a measure for that sympathetic comprehension of things Oriental which he displays throughout.

The Introductory Chapter is devoted first to an analysis of the effect of the late war upon Japan's place in the world and then to a brief résumé of her political development and her relations with other nations down to the period following the war with Russia.

Chapters I and II treat of the period up to the close of the sixteenth century. The account of the gigantic efforts of the Mongols to conquer Japan, in the last quarter of the thirteenth century, is especially praiseworthy and could only have been written by a practical seaman. The story of the Japanese invasion of Korea, three centuries later, also well told, brings out most clearly the decisive part played in that struggle by the control of the sea. Doubtless to many readers it will come as a surprise that the Koreans then produced an admiral who, alone of all the world's great sea fighters, can claim a place beside the victor of Trafalgar; the account of Admiral Yi-sun's operations and the effect they produced upon the outcome of the war as well as upon the entire subsequent history of the Far East, is one of the best portions of the book.

The two following chapters carry the narrative through the period of seclusion, down to the opening of the country, with the accompanying disturbances and outbreaks against the intruding foreigners; while chapters V and VI have to do with the Chino-Japanese War and the first alliance with Great Britain. The author shows the vital importance of Korea to Japan and the manner in which that peninsula has had so often to suffer because of its location between two great empires; while due credit is given to the now nearly forgotten efforts put forth by Japan, throughout the last quarter of the nineteenth century, toward the strengthening and upbuilding of Korea to form a really effective independent buffer state. But the reader's attention is of course mainly directed to the maritime aspects of the war, the description of the naval battle of the Yalu in this connection being probably the best account of that combat that has appeared in English. This part of the book makes particularly interesting reading in view of the precisely similar ways in which the geographical factors made their influence felt just a decade later, in the course of the Russo-Japanese War.

Chapters VII–IX deal with the Russo-Japanese War as influenced by the operations at sea. Its causes are discussed at some length, and the geographical setting is described, the fact being pointed out that in this respect all the advantage lay with the Russians save in the one particular of nearness to the theater of war. Attention is given to the movements of the

Japanese armies; and the various naval actions, particularly that known as the Battle of the Yellow Sea, whereby the Russian sea forces in the Far East were placed practically *hors de combat*, are graphically described. There follows the account of the later phases of the struggle, including the fall of Port Arthur and the long voyage of the Russian Baltic Fleet to its complete annihilation at Tsushima, with, finally, a clear and lucid discussion of the conclusions to be drawn from a study of the special features of the war.

The Conclusion, of nine pages only, treats of the results of the Russian War to Japan, the significance of her victory in connection with the development of the Far East, and her situation as regards the possibilities of a defensive war against any other Power.

The two appendixes have to do with the relative strengths of the Japanese navy and those of her opponents in the Chinese and the Russian wars respectively, and their interest is naturally mainly a technical one.

In a sense Admiral Ballard may be said to have anticipated the results of the Disarmament Conference held at Washington last winter; for he displays comparatively little faith in the efficacy of the big ship as an instrument of sea power, pointing out that Japan, with a couple of hundred submarines, could render it practically impossible for any foreign battle squadron to approach her shores or even to enter the Yellow Sea. And, speaking generally, the results of the conference do not in any way affect the validity of the author's conclusions, based as these are upon geographical rather than political considerations. Admiral Ballard's book deserves high commendation, both for its pleasing style and clear and well ordered method of presentation and because we have lacked hitherto anything in the way of a study, by a properly qualified writer, of the influence of the sea upon the destinies of the Far East during the historical period. A similar study, of that same influence during prehistoric times, still remains to be undertaken.

C. W. Bishop

An Archeologist's Labors in the Near East

E. A. W. Budge. **By Nile and Tigris: A Narrative of Journeys in Egypt and Mesopotamia on Behalf of the British Museum Between the Years 1886 and 1913.** Vol. 1, ix and 456 pp.; maps, ills; Vol. 2, viii and 456 pp.; maps, ills., index. John Murray, London, 1920. 63s. 9½ x 6½ inches.

The preface to these two handsome volumes by the Keeper of the Egyptian and Assyrian Antiquities of the British Museum indicates the character of the work—the results of over a quarter century's archeological labors in the Near East, given in narrative form. In the Prolegomena an account of the author's early studies, interesting for its personal touches, is of considerable value as a summary of the progress of our knowledge in this field in an important period (the seventies of the last century) regarding which little literature is available. Although we may not fully agree with his estimates of the character or work of those founders of Egyptology and Assyriology with whom he was brought in contact and in whose labors he participated, we can enjoy his careful and systematic collation of facts.

The first volume covers the period from 1886 to 1889; the second brings the narrative down to 1913. Both are crowded with detailed information with regard to the lands and peoples visited. In many ways the volumes would form an excellent guide to these regions because of their wealth of historical as well as archeological allusions. The facile command of resources, including a profound technical and linguistic training, and their skillful use in interpretation of the ruins visited call forth our admiration. Much of the narrative is written in a terse and pleasant style, though parts savor too much of the diary, marring the story and producing an unfortunate impression of padding.

Every traveler in the East will appreciate the sketch of the tiresome experiences met in dealing with Turkish and other officialdom and the author's shrewdness and diplomatic ability in handling such situations. We find that the ingenuity or perverseness of customs officers even can be made to serve the ends of science. Such for example is the suggestion that while "human remains" could not be exported, "bone manure" could.

Considerable space, including the final Apologia, is taken by the author to defend himself and the Museum's policy against various attacks. Some of these may be classed as blackmail and promptly dismissed; others are the work of defamers, probably envious of his successes; others the result of ignorance regarding the nature of the work. The whole history of the growth of the science of archeology goes to show that the natives of both Egypt and Mesopotamia have always destroyed, for their own reasons and purposes, all of those records of the past upon which they could lay their hands. Instead of abuse the highest praise should be meted out to such men as the author whose energy and knowledge have done so much to preserve these treasures and make them accessible to all students of history. The magnificent collection of the British Museum in this field will always remain a splendid monument to the zeal and wisdom of its main collector, our author.

William Libbey

Commerce and Communications between Spain and Hispanic America in Colonial Days

Gervasio de Artíñano y de Galdácano. **Historia del comercio con las Indias durante el dominio de los Austrias.** 350 pp.; maps, ills. Barcelona, 1917. 9½ x 7½ inches.

Cayetano Alcázar. **Historia del correo en América (notas y documentas para su estudio).** 347 pp.; ill. Madrid, 1920. 9½ x 6½ inches.

These two books prove that we are beginning to acquire well established information regarding the means of commerce and communication between Spain and her American dependencies and within those dependencies themselves—information as useful to the geographer as to the economist and the historian.

Artíñano points out (p. 75) that all the navigation which served to unite Spain and her American holdings, so far as they were united, was modeled upon the fleet with which Columbus discovered the New World, this being so in point of administration and supervision by the government and in point of internal organization of the trading fleets. Modifications and developments of various sorts came into being, but the underlying principles were quite unchanged. By a royal *cédula* dated July 16, 1561, it was forbidden that ships should fare forth one by one; they must go in fleets, and, for protection's sake, many a merchantman was armed almost as fully as if she had been a man-of-war. Artíñano emphasizes the fact that cargo space lost on account of armament was compensated for by the government. This point shows plainly the close relationship then existing between the commercial wealth and the naval power of the Spanish empire. A royal *cédula* of November 3, 1567, provided for a fleet of 12 light, swift galleons to serve as convoys and protectors for the more purely commercial vessels (p. 103). This was known as the "Flota de Barlovento." This defense fleet suffered somewhat violent fluctuations, as did most of Spain's institutions in America, and in the middle of the seventeenth century it seems to have had a period of marked decline, for we find it being specially restored to activity by a *cédula* of December 23, 1667. But it was soon found that the colonists were unwilling to support the immense expense of its up-keep, and again it declined in importance (p. 105).

The earliest fleets to visit America were purely exploratory and military in their nature, but there followed a period of settlement in the new lands, and a commerce intended to fill the needs of the colonists came into being. The custom of using fleets was partly due to climatic conditions, for the most propitious season for traffic was found to be the summer months, and thus it happened that accidental fleets of independent ships were formed, all passing to America in April and May.

In addition to these conditions, there were regulations by the score touching upon who should and who should not go to America. These had a marked geographical consequence for the reason that, had the regulations been different, more Spaniards of both sexes would have gone to the colonies, and so the racial and anthropogeographical factors there would have been profoundly influenced by the influx of a more sizable Castilian element.

The work of Alcázar does for land communications much the same service that the work of Artíñano performs for sea travel. This does not mean, of course, that Alcázar has nothing to say about sea-borne mails. His first chapter gives a brief, but exhaustive, account of the courier posts which performed such important services in the Aztec and Inca empires before the coming of the Castilians. The geographical importance of those courier posts (services for the sending of messages by means of relays of swift runners) was, in those two empires, precisely similar to that of the analogous institution in the old Persian empire. They were huge political creations due to the genius of dominant tribes which had had such superior intelligence, initiative, and daring that, in each case, the directing tribe had learned how to overcome great geographical barriers of several kinds, and had so created a state of wide variations, both environmental and ethnographic.

Only the bringing into existence of machinery which would tend to minimize the effects of great distances would make the life of such a state more than transiently possible.

The succeeding chapters of Alcázar's work show that the Spaniards hardly equaled their predecessors in respect to the courier posts. In Chapter 2 is traced the history of the great post of Correo Mayor de Indias (Postmaster General of the Indies). On October 27, 1525, Charles V confirmed the appointment made by Ferdinand in 1514 of Dr. Lorenzo Galíndez de Carvajal as Correo Mayor de Indias. Haring (C. H. Haring: Trade and Navigation between Spain and the Indies in the Time of the Hapsburgs (Harvard Economic Studies, Vol. 19), Cambridge, Mass., 1918, pp. 34 and 35) states that the post remained in the Carvajal family until 1627, but that "the family of Carvajal seems to have retained control of some of the South American posts till 1768." According to Alcázar, however, the great office in question remained constantly in the hands of the Carvajal family until 1768. The powers and privileges accorded to the Correo Mayor were very important, as were also the obligations to which, at least on paper, he was bound to give fulfillment. Reading over the Capitulaciones between Luis de Velasco, Viceroy of Peru in 1596–1604, and the fourth Correo Mayor, Diego de Carvajal Vargas y Ortiz, signed in April, 1599, at Lima, one gets the impression that the postal service must have been admirable. So it was in theory; but one suspects that, in cold fact, such was not the case. In reality the very act of giving over such an important charge to one family was indicative of the manner in which the King of Castile often unconsciously collaborated with the geographic factor to create a very uneven distribution of Spanish authority and Spanish culture in his American possessions. No doubt many of the Correos Mayores were able men; but, even so, the patrimonial character of their office must have seriously interfered with whatever chances there were of its being put on a "strictly business basis."

Of the remaining chapters of Alcázar's book Chapter 7 (pp. 99-114), treating of the sea-borne mails, is especially interesting to geographers. Established in 1764, this service appears to have been a belated attempt to strengthen the ties between Spain and the colonies. Ships were to sail every month and make a rapid journey to America, carrying mail and passengers. The port of departure in Spain was La Coruña, and the American terminal was Havana, where distribution of the mails for delivery to various parts of America was made. Mails for Peru went by way of Buenos Aires, a sailing from La Coruña to that port occurring every two months. In other words, a mail service not very dissimilar to those of modern times came into being. If it had the desired result of lessening the gulf between mother country and colonies, that result came too late to prevent a rupture which had long since become inevitable.

Philip Ainsworth Means

Vegetation of the United States

B. E. Livingston and Forrest Shreve. **The Distribution of Vegetation in the United States, As Related to Climatic Conditions.** xvi and 590 pp.; maps, diagrs., bibliogr. *Carnegie Instn. Publ. No. 284.* Washington, D. C., 1921. $9.00. 10 x 7 inches.

The aim of the present volume is "to bring forward certain types of the methods that may be employed in studying the etiology of plant distribution and to present some of the climatological data necessary to such work in the United States." The basic principles upon which the work is grounded, as set forth in the Introduction, are essentially two. (1) The plant in its relation to environment is regarded as a physiologically active organism, the visible manifestation of which is seen in "growth form." Vegetation is similarly looked upon as "the total plant population of an area viewed from the anatomical and physiological rather than the taxonomic and floristic standpoint": it is to be judged with reference to what the reviewer would term its physiognomy and ecological structure. "The study of vegetation *as such* has been, on the whole, greatly obscured by the fact that it has never been completely divorced from the study of the flora. Too much emphasis cannot be laid, at the present time, on the radical distinctness of the work of physiological plant geography, on the one hand, which attempts to relate the occurrence and distribution of species as physiological entities, to the factors of environment, and the work of floristic plant geography, or phytogeography, on the other hand—which attempts to reveal the geological history, the movements, and vicissitudes of species as phylogenetic entities." (2) It is assumed "as a law of plant geography that the existence, limits, and movements of plant communities are controlled by physical conditions" and that "the conditions that control the broader geographical limits [of the community] are almost solely those of the climate." The work is divided into three parts, the essential features of which are outlined below, and is replete throughout with maps, tables, and graphs which will be welcomed by all workers in this field.

Part I has to do with the facts of vegetational distribution. Shreve's earlier account of the vegetation of the United States ("A Map of the Vegetation of the United States," *Geogr. Rev.*, Vol. 3, 1917, pp. 119–125) is here taken as the primary basis, his vegetation map being reproduced without change and the accompanying descriptive material with considerable amplification. This study is now supplemented, however, by a discussion of the distributional areas of various conformic groups of plants (i.e. of plants having the same growth forms) and also of a relatively large number of individual species, these latter so selected as to include a few of the dominant plants in each of the leading vegetations.

Part II is concerned primarily with the presentation of data to show the character of the leading climatic features in the United States, with particular reference to conditions of temperature and moisture which are influential in controlling plant distribution. For the solution of problems in plant distribution it is the conviction of the authors that climatological methods and climatological interpretation, as developed thus far, are "wofully inadequate" and that little real advance along this line can be looked for until many new methods have been devised and tested. "What ecological climatology requires is fundamental study of the climatic conditions *as these are effective to alter physiological processes*." The authors' own contributions in this field during the past fifteen years have been noteworthy and their present summary of climatic conditions is based partly on these and partly on the published work of other investigators.

In the discussion of temperature conditions, stress is laid on (1) their duration and (2) their intensity. As regards the duration of temperature conditions, the length of the period of the average frostless season is looked upon as having the greatest significance, other features taken into consideration being the length of the period of high normal daily mean temperatures and also that of low normal daily means. In the matter of temperature intensity, attention is directed to various indices of temperature efficiency in relation to plant activity during the average frostless period, viz. direct indices, remainder indices, exponential indices, and physiological indices, especial emphasis being placed on the latter; also to absolute temperature maxima and minima and to the mean normal temperatures for the year for the coldest fourteen days and for the hottest six weeks. On a basis of these various temperature criteria, a division of the United States is proposed into five temperature provinces, viz. very cool, cool, medium, warm, and very warm.

The moisture conditions dealt with are those of (1) precipitation, (2) evaporation, (3) aqueous vapor pressure, (4) relative humidity, (5) wind, and (6) sunlight. With regard to precipitation in its relation to plant activity and distribution, the normal mean daily precipitation for the period of the average frostless season is regarded as the most important single criterion, but account is also taken of the normal precipitation for this period plus the preceding 30 days, of the number of normally rainy and dry days and the length of the longest normally rainy and dry periods during the frostless season, and of the normal annual precipitation. With reference to these various precipitation criteria the United States is divided into four precipitation provinces, viz. humid, semihumid, semiarid, and arid. The names given these provinces are later applied to four corresponding provinces based on evaporation, on aqueous-vapor pressure, on relative humidity, etc. The evaporating power of the air as a climatic feature affecting plant distribution is regarded as being fully as important as precipitation, and the limited available data on this subject are considered in some detail, with particular reference to the conditions prevailing during the frostless season. Stress is further laid on the ratio between precipitation and evaporation, especially during the frostless season, and the method employed by Transeau ("Forest Centers of Eastern America," *Amer. Naturalist*, Vol. 39, 1905, pp. 875–889), somewhat modified, is extended to cover the whole United States. Aqueous-vapor pressure and relative air humidity furnish several moisture indices, the normal mean relative humidity index for the period of the average frostless season being regarded as the most valuable of all available desiccation indices by reason of the relatively large amount of accumulated data on this phase. The section on climate, which includes nearly fifty maps as well as numerous tables and graphs, concludes with an attempt at combining various series of moisture and temperature indices to obtain a single series of moisture-temperature indices, and on a basis of these the division of the United States is suggested into twenty climatic provinces, viz. very warm humid, very warm semihumid, etc.

In Part III an effort is made to correlate the two bodies of data presented in Parts I and II in such a way as to learn the exact range of climatic conditions with which each plant or vegetation is associated. To this end, for each of the vegetations, plant groups, and plants discussed in Part I a table is presented (129 tables in all), on which are given the maximum and minimum values for each of the climatic conditions emphasized in Part II, and various comparisons are made between the positions of isoclimatic lines and lines drawn to show the limits of botanical areas, for the purpose of discovering correspondences. One interesting feature of this section consists in the cartographic presentation of the climatic conditions in each of the various vegetation areas here recognized and also in each of the "life zones" distinguished by Merriam ("Laws of Temperature Control of the Geographic Distribution of Terrestrial Animals and Plants," *Natl. Geogr. Mag.*, Vol. 6, 1894–95, pp. 229–238), the opinion being expressed with regard to Merriam's system that, while it formed an excellent beginning, it "will require much modification before it can become at all satisfactory to a serious student of etiological plant geography." The general conclusions of the authors regarding their own results are (1) that, while the parallelism existing between the distribution of many closely related climatic conditions makes it difficult in some cases to determine which of the several aspects of a particular condition is of greatest importance in controlling the distribution of a particular plant or vegetation, nevertheless the methods used rarely fail to demonstrate whether it is the temperature group of conditions or the moisture group that is of greatest importance; and (2) that in the case of the generalized vegetation areas of the United States one of the most clear-cut evidences of correlation is seen in the correspondence in position between the vegetation boundaries and the isoclimatic lines expressing certain values of the moisture ratio for the average frostless season.

It is unfortunate in many respects that the area treated by this work is bounded in part by political rather than geographic boundaries, since it seems inevitable that such unnatural limitations must lead to misconceptions in the case of vegetation regions which, with their accompanying climatic conditions, extend into areas that are not treated. This is true, for example, of the northeastern mesophytic evergreen forest, which attains its greatest development in Canada, being at best but poorly developed in the United States. It is also unfortunate, in the opinion of the reviewer, that somewhat more stress is not laid upon the *climax* character of the vegetation which typifies the great vegetation regions and particularly upon the relation of such climaxes not only to climate but to physiography. It may be quite true that "in the majority of the great vegetational areas with which we have to deal, the prevailing soil is a clay or a clay loam" and that "the prevailing vegetational types are, in the majority of cases, found upon this character of soil"; but there is at least one noteworthy exception to this rule, viz. the "southeastern mesophytic evergreen forest" of the Atlantic Coastal Plain. Surely this great plant formation of predominantly sandy soils cannot be compared with the formations of clays and clay loams without giving great prominence to the influence of physiographic factors in determining the nature of the environmental complex.

In any piece of work which deals with natural phenomena, however, where an attempt is made to bring out a correlation between cause and effect, personal bias is apt to lead to an undue stressing of certain features at the expense of others; and at any rate some difference of opinion is inevitable when it comes to the interpretation of the facts. The present work, without question, represents the most comprehensive effort yet made to interpret the known facts of plant distribution in this country in their relation to climate. It is the most searching investigation of the sort that has ever been published for any area of comparable size, and as such it is a milestone in the progress of climatological ecology.

George E. Nichols

A Manual of Zoögeography

E. L. Trouessart. **La distribution géographique des animaux.** 332 pp.; maps, ills., index. (Encyclopédie Scientifique; Bibliothèque de Zoologie, C. Houlbert, Director.) Librairie Octave Doin, Paris, 1922. 7 x 5 inches.

This volume is by a leading French authority on mammals, who has long been interested in the geographical distribution of animals. It is a new work and not a revision of his earlier "La Géographie Zoologique" (1890). The standpoint, however, has not changed materially and is that of the faunal student primarily concerned with taxonomy, descent, and the genetic study of faunal areas as contrasted with the ecological point of view, or the relation of these animals to their environment, and thus it represents the older method of approach rather than the more recent. A truly balanced treatment will give equal weight to both points of view, and this is much needed today. Trouessart clearly recognizes the value of continental evolution, the geological history of their faunas, their migrations, centers of origin, and dispersal. In these respects he is distinctly modern.

About half the volume is devoted to those geographic factors which influence distribution, as composition of the medium, topography, altitude, climate, food, insular conditions, locomotion, migrations, transportation; and the migrations of birds receive special attention. The discussion of marine conditions includes the composition of the water, temperature, pressure, currents, migrations, the abyss; and the bionomic districts and faunal regions are outlined. The fresh-water fauna, including that of lakes and subterranean water, and finally the terrestrial fauna and that of caves are briefly characterized. While all these influences are ecological factors the viewpoint remains faunal throughout.

Considerable space is given to the discussion of the major terrestrial faunal regions and to listing their representative animals. The faunas of the sea are briefly outlined. The author calls attention to Houlbert's ideas that, among certain insects, the giants of the groups are indicative of their centers of origin; but there is no general discussion of the principles involved in the determination of such areas. He suggests that the fauna of the Fiji Islands indicates that this archipelago is a fragment of a submerged continent. Considering the book as a whole, it must be regarded as an important summary from the faunal standpoint and one that contains much of value to geographers and geologists, as well as to zoölogists, particularly to the student of mammals. We note that for the sake of brevity only a few references were given. This is unfortunate, as the author is well qualified to include many writings that would have enhanced the value of the volume.

Charles C. Adams

A Description of the World's Climates

W. G. Kendrew. **The Climates of the Continents.** xvi and 387 pp.; maps, diagrs., bibliogr. index. Oxford University Press, American Branch, 1922. $7.00. 9 x 5½ inches.

Until the appearance of this book there was no English work that adequately covered the climates of the continents. Climatologists the world over have used Hann's "Handbuch der Klimatologie" for frequent reference and will continue to do so. But those not conversant with German have longed for some such book in English. British and American teachers of geography, especially, have had no textbook on which to base a course on the climates of the world and no ready reference work for their regional courses. Ward's "Climate Considered Especially in Relation to Man" could form only a valuable background for such studies.

In the introductory portion of the work the author gives a concise discussion of climatic statistics (Ch. 1) and of the pressure and wind systems (Ch. 2). Then in succession he presents Africa (78 pp.), Asia (108 pp.), Europe (65 pp.), North America (41 pp.), Latin America (42 pp.), and Australia and New Zealand (30 pp.). An American is struck with the relative brevity of the climatic discussions of North and South America but is thankful that Africa, Asia, and Europe are so fully treated. We have conveniently at hand a number of excellent publications covering the climatology of the United States and Canada but cannot so readily study the climates of the other continents. One reason for the small space devoted to American climatology seems to have been the author's lack of study of the numerous discussions to be found in the *Monthly Weather Review*, the *Annals of the Association of American Geographers*, and the *Geographical Review*. The rainfall maps of the United States used are wholly inadequate ones published nearly 30 years ago. In the discussion of temperature no mention is made of the now widely known heat of Death Valley, California, where under standard conditions a temperature of 134° F. was observed in 1913. Californians would have difficulty in recognizing their July temperatures on a map of "Mean [sea-level] temperature in July" (p. 279) which shows neither the heat of the Great Valley nor the coolness of the Sierra Nevadas. Snowfall is handled gingerly; and such baseless hearsay as "On the mountains of Wyoming a total fall of 180 feet is said to have been measured in one winter" is presented in lieu of definite information published in the *Monthly Weather Review* three to eight years ago and in the British *Quar-*

terly Journal of the Royal Meteorological Society nearly ten years ago. To show the distribution of tornadoes in the United States the author uses a map prepared 35 years ago when such statistics for much of the Middle West and the South were far from adequate. These are small points, however, and detract little from the otherwise comprehensive and interesting treatment of our climates.

The book is largely devoted to descriptions and explanations of the various climates and contains numerous references to their effects on man. Typical of the author's incisive style is the description of the dynamics of the meteorology of the heart of Asia (p. 155). Comparisons are frequently made between eastern and western coasts of continents and between the climates of places in corresponding locations on different continents. Valuable are the extensive tables of monthly average rainfalls and temperatures for about 420 stations on the various continents and their outlying islands. It is a pleasure to read such a well written, well illustrated, vivid, and accurate book, and a greater pleasure to commend it to others.

Charles F. Brooks

Geographical and Geological Observations in the Weddell Sea and Its Borders

J. M. Wordie. **Shackleton Antarctic Expedition, 1914–1917: The Natural History of Pack-Ice as Observed in the Weddell Sea.** Ills., diagrs., bibliogr. *Trans. Royal Soc. of Edinburgh*, Vol. 52, Part IV, No. 31, 1921, pp. 795–829.

J. M. Wordie. **Shackleton Antarctic Expedition, 1914–1917: Depths and Deposits of the Weddell Sea.** Diagr., bibliogr. *Trans. Royal Soc. of Edinburgh*, Vol. 52, Part IV, No. 30, 1921, pp. 781–933.

J. M. Wordie. **Shackleton Antarctic Expedition, 1914–1917: Geological Observations in the Weddell Sea Area.** Map, diagrs., ills. *Trans. Royal Soc. of Edinburgh*, Vol. 53, Part I, No. 2, 1921, pp. 17–27.

The voyage of the *Endurance* afforded an opportunity for 17 months' study of the ice of the Weddell Sea—December, 1914, to April, 1916. After the ship was destroyed in October, 1915, the party camped on the ice floes, finally escaping through the edge of the pack to Elephant Island.

The ice pack of the Antarctic closely resembles that of the Arctic despite the prevailing impression to the contrary. Sea ice may be divided into (1) fast ice, which remains fixed at least during the winter, and (2) pack ice. Described in terms of structure, it is young ice or hummocky ice. Young ice always has platy structure and a relatively smooth surface; while hummocky ice has generally become spotted or granular, and the surface has been broken and built up into hummocks.

In the Weddell Sea young ice formed usually in still water. Tiny horizontal plates of ice coalesced at the surface, forming a layer one-quarter to one-half an inch in thickness. Below, the arrangement of crystals was mainly vertical. Ice flowers were common on newly frozen leads in winter, forming apparently around surface brine bubbles as nuclei. Young ice frequently showed horizontal banding due to density differences; it was notably more plastic and less salt than old, hummocky ice.

Throughout most of the Weddell Sea the ice was constantly breaking up and drifting to the north and west. Of special interest were the cracks and other pressure phenomena resulting from the continual motion. Three principal types of cracks were noted. At very low temperatures, contraction due to a fall in temperature would cause cracks. Most common were cracks resulting from various strains. There were also cracks due to heavy pressure from the moving ice pack itself. It was easy to see how pressure was produced by the different rates of travel of floes of different density, size, shape, and thickness. "Every hummock acted as a sail." Floes were constantly overtaking one another, bumping, screwing, and swinging. Pressure was accompanied by bending, characteristic of thin, plastic ice; or in heavier floes by tenting, in which the ice rose in an inverted V; or, most commonly, by rafting, where one floe overrode another or dovetailed with it. The height of pressure ridges built up of blocks of sea ice has often been exaggerated. The pressure ridges seen in the Weddell Sea were rarely as high as 15 to 20 feet. An advancing pressure ridge would overload the ice and cause a weight crack to open ahead of the ridge and parallel to it. Numbers of radial cracks, also, prepared the ice for further hummocking. The colliding of blocks of ice often caused chock cracks, likewise transverse to the pressure ridge.

The drift of the ice pack in the Weddell Sea was controlled by the wind direction, the deflective effect of the earth's rotation, and possibly by a current. As the prevailing wind was southeast, the ice took a westerly course, making the east coasts safest. During its travels notable changes took place in the ice. In the Weddell Sea, year-old ice not rafted attained a maximum thickness of about five feet, its growth depending largely on the snow covering. The age of a floe could be surmised from the discolored band marking the summer growth of diatoms in the ice. Ice either afloat or hummocked lost its fibrous character and became spotty or granular when subjected to temperatures around freezing. It also became gradually less salt; indeed hummocked ice, after a summer's exposure, became fresh enough to furnish drinking water.

In the ice cycles of the Arctic and Antarctic pack one conspicuous difference may be noted. In the Arctic, fresh pools from melting of the snow surface are common; in the Antarctic these rarely occur. In the Weddell Sea, surface melting would merely render the snow granular and not affect the ice beneath. The decay of the pack was caused mainly by the swell and mechanical breaking up of the floes. The blocks were then probably carried out through Bransfield Strait and finally melted in the open sea.

The soundings made in the Weddell Sea by the *Endurance* in 1915 supplement earlier observations and indeed cover parts of the sea where no previous soundings had been taken. Soundings were made frequently, usually when the ship was held by pack ice—the table shows a total of 52 soundings taken in the nine and a half months, December, 1914, to September, 1915, when sounding apparatus and specimens were necessarily abandoned through the loss of the ship.

The deposits obtained were mostly brownish or gray glacial muds, with occasional traces of sand. Very sandy deposits were found only off Coats Land and in latitude 70° S., longitude 40° W., though no land was visible from the latter location. Pebbles and rock fragments were most abundant along the Coats Land coast. In this vicinity quite a variety of specimens was obtained, but gray granite and gray to green grits were the only common rocks. Farther from land white quartzite and gray grit predominated. Apparently here, also, the source of the material was to the east.

The main bathymetrical results of the *Endurance* soundings were:

1. The 1000–2000-fathom lines apparently cross from Coats Land to Graham Land uninterrupted, making the existence of the so-called "Morrell's Land" highly improbable.
2. A deep channel appears to run southward through the middle of the sea.
3. East of the channel the bottom slopes gently up to the narrow, continental shelf off Coats Land. The irregularity of this shelf, together with the mountainous character of the snow-covered land, indicates hills and valleys in the rock beneath.
4. West of the channel the continental shelf rises more abruptly and is wider and more uniform. More than a hundred soundings were taken in four months of drifting back and forth on this shelf. These soundings were mostly at depths either from 180 to 190 fathoms or from 250 to 260 fathoms and showed a series of stepped terraces running southwest to northeast. Now the shelf of Antarctica is about twice the usual depth of continental shelves. One explanation offered is that the shelf was planed down by ice, formerly more extensive. This idea is disproved by the existence of these terraces, which would seem to indicate faulting. The depth of the shelf may be due to some earth movement, then, rather than to erosion. The *Endurance* failed to get satisfactory observations of the slope of the continental edge and obtained no new evidence on the relationships of the island groups to the north of the Weddell Sea.

The geological results of the Shackleton Expedition were limited, as no landing was made on the Antarctic continent. Mr. Wordie found that the edge of the continual ice sheet was practically everywhere afloat, and one iceberg twenty miles long was seen. The opportunities to study the geology of South Georgia and Elephant Island established, in the one case, the strongly folded character and largely Mesozoic age of the rocks and, in the other, provided information from an island on the inhospitable, precipitous shores of which the Shackleton Expedition made the first landing.

The eastern part of the northern shore of Elephant Island consists mostly of greenish schist. The island, which is some thirty miles long and perhaps fifteen wide, is youthful physiographically and shows evidence of submergence. Its interior appears to be a plateau of 1500 feet in height from which mountains rise to over 3000 feet. Great glaciers tumble into the sea.

Although the geological similarity of Graham Land and South America no longer admits of any doubt concerning their morphological identity, their connection through the eastward bow of islands is by no means established by the last evidence obtained by Mr. Wordie. The rocks of South Georgia, the South Sandwich Islands, the South Orkneys, and Elephant Island differ markedly from one another and from those of Graham Land and South America. Only the folding is suggestive of relationship. Obviously the answer to the question can be established only by fuller charting of the ocean depths in this section.

Charles F. Brooks

A Manual of Tides

H. D. Warburg. **Tides and Tidal Streams: A Manual Compiled for the Use of Seamen.** vi and 95 pp.; diagrs. The University Press, Cambridge, 1922. 8s., 6d. 9½ x 7 inches.

Commander Warburg states that the primary purpose of this manual "is to explain the tides to seamen." Of the nine chapters comprising the text, the first is concerned with the tide-producing forces, the second with the tides as they exist; the five following chapters deal with the prediction of tides; the eighth is devoted to oceanic currents and tidal streams; and the last deals with tides and tidal streams in hydrographic surveying.

The greater part of the book is devoted to explaining the methods used in the prediction of tides, examples being given to illustrate the method of tidal differences and also the approximate prediction by means of harmonic constants. Very little space is devoted to what may be called the geographical aspect of the tides—the description of the tides and tidal phenomena actually found in nature; explanations for the existing variations in time, type, and range of tide; and the relations between tide and tidal currents.

The book is addressed to seamen and should prove useful in acquainting them with the harmonic method of tidal prediction and with the advantages of specifying the tide at any place by means of harmonic constants. However, the advisability of the author's departure from the usual procedure in two cases is open to question—the substitution of "semi-amplitude" for the amplitude of the harmonic constants and the change in the values of the astronomic arguments in the tables of the appendix, made necessary by the reversal of sign in these arguments.

H. A. Marmer

THE GEOGRAPHICAL REVIEW

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The Frontiers of Language and Nationality in Europe. By LEON DOMINIAN. With eight maps in color and twelve in black-and-white, and numerous photographs. xviii and 375 pp. [*Special Publication No. 3.*] 1917. $3.00 net. Out of stock.

The Face of the Earth As Seen from the Air: A Study in the Application of Airplane Photography to Geography. By WILLIS T. LEE. With 67 oblique and vertical airplane photographs and 15 maps. xii and 110 pages. *Special Publication No. 4.* 1922. $4.00.

THE
GEOGRAPHICAL REVIEW

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AN AMERICAN BOUNDARY DISPUTE

DECISION OF THE SUPREME COURT OF THE UNITED STATES WITH RESPECT TO THE TEXAS-OKLAHOMA BOUNDARY

By ISAIAH BOWMAN

[With separate maps, Pl. I facing p. 166, and Pl. II, facing p. 168, and Figs. 20 and 21 on Pl. III, facing p. 182]

During the past few years we have seen many thousands of miles of international boundary in Europe confirmed or revised here and there or relocated altogether or left in dispute. Designed to quiet title to land and to create a more stable régime than Europe had enjoyed, the attempted settlement in many cases has given rise to new difficulties. That this was probably inevitable in any program of reconstruction does not alter the fact that in most cases titles to newly acquired land are still insecure. In several instances a plebiscite was held in order that the wishes of the inhabitants might be decisive, but the effect (in Silesia, for example) has been to create fresh issues without altogether allaying the original trouble. The whole of Upper Silesia, the Memel district, the Polish Corridor, and the northern zone in Slesvig are now shown on certain German maps as territory "temporarily" held by bordering powers. For many years the Tacna-Arica district in northern Chile has been represented on Peruvian maps as "occupied by Chile." Unless boundaries become fixed by general consent, or at least confirmed by general acceptance, and their importance minimized in any event by equitable economic agreements, the political map may again be altered with tragic consequences.

To recall these few instances from among the many that lie scattered throughout the world, particularly in Europe, is to gain a fresh idea of the exceptionally fortunate geographical conditions and the wise counsel that led to the union of the thirteen colonies to form one nation, and of the equally fortunate circumstances that led to the extension of one flexible and modern type of government over so large and diversified a part of North America. Our regional problems are often difficult to solve, and it took a four-years' war to settle the worst of them. But boundary questions, as

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distinct from regional disputes, have never had a disrupting effect. Under our constitutional system provision is made for the settlement of boundary difficulties between states by reference to the Supreme Court of the United States as the court of original jurisdiction.

There are many reasons, social, geographical, and political, why it is easy for us to settle boundary disputes between states. It suffices to name one circumstance perhaps more significant than all others combined, namely, that whether a boundary is placed here or there the people concerned live under substantially the same constitutional régime. This means that they enjoy the same liberties of speech and action and suffer no greater or less discriminations based on past wars and persecutions. There are local exceptions to be sure; and we are not guaranteed immunity from regional and racial quarrels. Our watchtowers must always be manned.

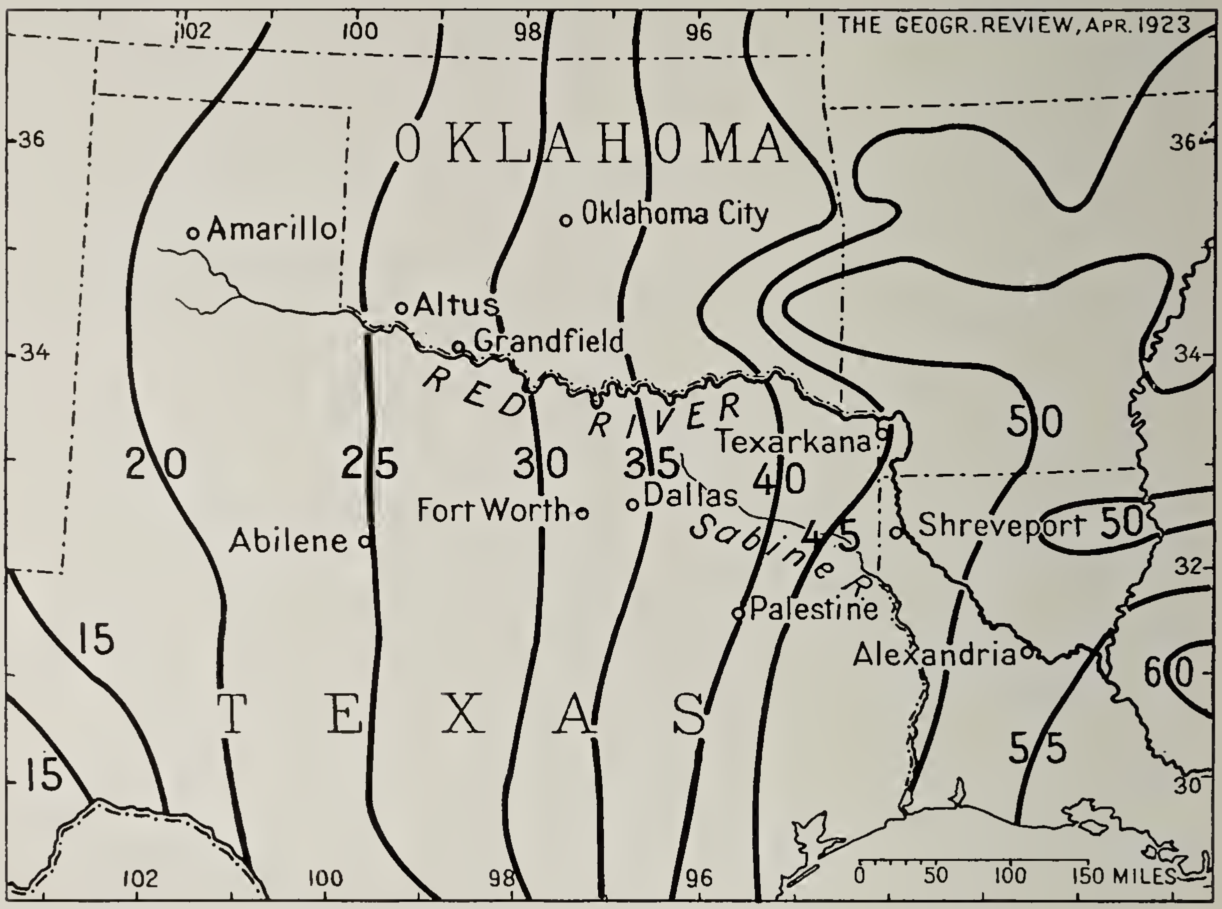

FIG. 1—The Red River is situated in two quite different climatic regions. It rises in the dry region known as the High Plains and flows eastward into the moister prairies. On the above map the mean annual rainfall is shown in inches. The rainfall is more variable and violent in occurrence in the upper Red River than in the lower. This favors the irregular delivery of large quantities of land waste to the main stream but not its ready removal.

STATE BOUNDARIES OF ECONOMIC INTEREST

Point is given to the disputes that we have, chiefly by reason of the economic (not the political and social) effects of the ultimate decision. Such was the interest in the dispute between Alabama and Georgia in the famous case of the Chattahoochee, involving the location of an interstate boundary on the western bank of that river. Were a decision to be handed down excluding the inhabitants of one state from access to a navigable river on its border, a hardship would be imposed upon the farming population immediately adjacent and also upon manufacturing and shipping interests that had become accustomed to the use of the river as a highway.

Even if we take such cases into account, the economic interests involved in court decisions affecting streams have not been of the first importance when contrasted with the total economic activity of a given region. Though the use and control of the water of western streams where irrigation is the rule have been fundamental to the life of whole communities, the latter type of decision has not been notably involved in boundary disputes and lies outside the range of our present investigation.

The latest boundary decision of the Supreme Court of the United States relates to the Red River. It disposes of the most complicated boundary dispute on record anywhere; and a settlement of the question involved research in history, physiography, plant ecology, surveying, engineering, and hydrology, as well as the law. From a geographical standpoint the case is undoubtedly unique. It is also one of the tensest cases on record in the United States. Yet by a decision of the Supreme Court a boundary 321 miles long in a straight line, or a distance as great as from Vienna to Berlin or from Berlin to Warsaw or from London or Paris to the Ruhr, was finally settled not by troops, or a plebiscite, or an elaborate treaty, but by a mere pamphlet consisting of fourteen pages of printed text. The only "guards" required about the receivership area, as established by the court, pending a decision, were small white stakes marked "U. S. Supreme Court Temporary Point, No. ——."

An Unsettled Question for One Hundred Years

The Red River forms the boundary between Texas and Oklahoma for a distance of 539 miles by river, or 321 miles in a direct line. Strange to say, this boundary, although fixed by a treaty with Spain that was signed in 1819 and ratified in 1821, over a hundred years ago, was not settled until January 15, 1923, when the Supreme Court handed down the last of three decisions affecting the question. By the first decision, that of April 11, 1921, the court found "the south bank of Red River" the true boundary between the two states, and not "the medial line of the stream, as claimed by Texas." By the second decision, that of May 1, 1922, the court found that "no part of the [Red] river within Oklahoma is navigable and therefore that the title to the bed did not pass to the state on its admission to the Union." Any claim by Oklahoma to a part of the bed was declared incidental to ownership of riparian lands on the northern bank. The rights of riparian owners on the northern bank to the bed were to extend only to the medial line between the "cut banks" of the river. Finally, by the decree of January 15, 1923, the southerly cut bank was made the

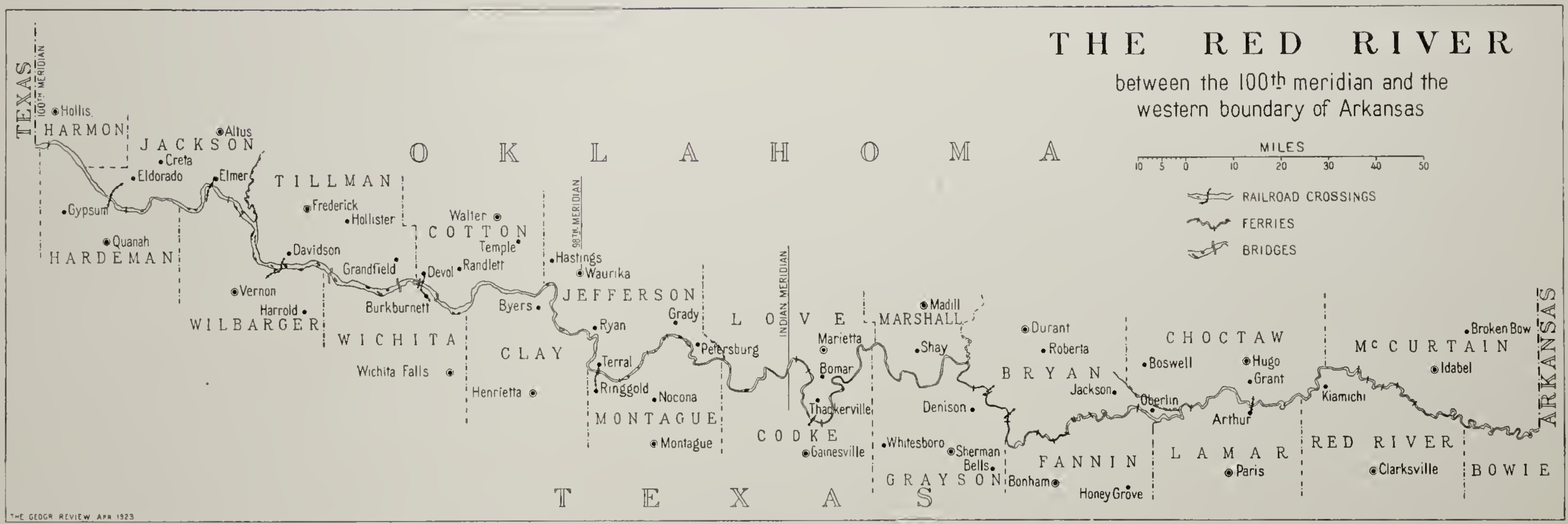

FIG. 2—The Red River here forms part of the boundary between Texas and Oklahoma for a distance of 539 miles following the sinuosities of the stream, or 321 miles in a direct line. The curves and variable widths are shown to scale. Opposite Byers in Clay County the width of the river bed narrows noticeably, and there is progressive and anomalous narrowing *downstream* to the vicinity of Denison in Grayson County. Thence downstream the river widens, though it is nowhere else so wide as in its upper portion from the 100th meridian to Byers. Noticeable also are the large and numerous islands (see Fig. 7) in the upper river and the scarcity of all but small islands in the lower section of the river. The upper river, receiving more waste than it can carry competently, has its course strewn with islands which, with the innumerable sand bars, thrust the river from side to side in the most changeful and pronounced manner. The river in flood flows as a broad waste-laden sheet of water. With rising water there are picked up on the bed of the stream or carried forward from the mouths of tributaries great quantities of material some of which is temporarily deposited again as soon as the supply of water falls off. The moment it is deposited it becomes an obstruction, and the broad sheet of the river is then broken up into a number of separate channels of highly irregular pattern. Farther downstream, where the volume of water is greater at all seasons, the waste is kept under control; the river develops curves of regular pattern; the changes that take place are systematic. The upper river with its island-strewn bed is a braided stream; the lower river is a regularly meandering stream. The "Encyclopedia of Oklahoma," 1912, pp. 11 and 65, defines the Base Line and the Indian Principal Meridian (see center of map) as lines that extend east and west and north and south respectively through a sandstone pillar located one mile south of Fort Arbuckle on the boundary between Murray and Garvin counties. The approximate positions of these two fundamental lines are 34° 31′ N. and 97° 14′ W. From them all land locations in Oklahoma are computed except for that portion of the state west of the 100th meridian. A bridge should have been indicated opposite Byers.

boundary between Texas and Oklahoma so far as surface jurisdiction and use are concerned.

The United States Owns Half the River Bed

The last decision has one feature of curious interest: *It establishes ownership by the United States of a narrow strip of land on the bed of a stream between the medial line of that bed and the southern cut bank, a strip that shifts its position from flood to flood by two distinct processes (avulsion and erosion) one of which leaves the boundary unchanged while the other alters the boundary.* It excludes not only Oklahoma but also private claimants from ownership of the "soil" in the southern half of the river bed. Private claimants, relying upon placer mining laws, had entered and developed lands in the southern half of the bed. The court held that they had no rights because by the laws and treaties controlling the disposition of lands in Oklahoma the mining laws were excluded. The court recognized the constitutional rule of equality among the states whereby each new state, like the original states, became the owner of the beds of its navigable streams; but by declaring the Red River unnavigable it, in effect, held that the title remained in the United States subject to the Indian rights and then further held that the title to the northern half of the river bed passed from the United States and the Indians to the riparian owners of the north shore, as the lands fronting on the north bank were sold or allotted.

Geography of the Disputed Zone

With the decisions of the court in mind it will be worth while to examine Figure 1, which shows the general geographical situation and the rainfall; Figure 2, which gives a more detailed view of the boundary zone; and the colored maps, Plates I and II, which give details of the river's course in the most critical part of the disputed zone. It is only after an examination of these four maps that the reader is prepared to follow the next phase of the discussion.

Ten Oklahoman counties and eleven Texan counties border the river along that part of its course which forms a boundary between Texas and Oklahoma. These counties include 11 per cent of the total population of Oklahoma and 9 per cent of the population of Texas. Of the twelve largest towns in Oklahoma but one is within 20 miles of the Red River, and one of the twelve largest in Texas. Nine railway lines cross the river, besides a number of wagon bridges. Within a belt twenty miles wide on either side there are 100 incorporated places; and, of these, 63 are in Oklahoma and 37 in Texas.[1] The valley of the Red is bordered, and its floor throughout the lower or eastern half of the region in dispute is covered, by rich plantations producing corn and cotton chiefly, and there is a certain amount of stock raising. Added to these interests are those of the oil industry.

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[1] Of the 63 incorporated places in Oklahoma, according to the 1920 census, one has a population of over 10,000; eight have from 2500 to 10,000; 30 have from 500 to 2500; and 24 have less than 500. Of the 37 incorporated places in Texas, four have a population of over 10,000 (including Wichita Falls, 40,079); ten have from 2500 to 10,000; 15 from 500 to 2500; and eight less than 500.

In 1918 oil was discovered along the valley; and among the richest oil pools are those that lie under the bed of the river itself and the flood plain and adjacent terraces of the valley floor. The wells are scattered throughout a stretch 43 miles long south of Grandfield, Okla., or south of what was known as the "Big Pasture."[2] Some of the wells are located in the bed of the stream itself (Figs. 20 and 21, Pl. III, facing p. 182). Up to the time that oil was discovered the moderate or normal economic value of the land and of the broad, half-dry bed of the river throughout the upper half of the boundary zone led to the undisputed occupation of the land down to the cut bank of the river on either side; but when oil wells were drilled the question of location became important down to the last foot, not only from the standpoint of the property owner himself but also from the standpoint of the state and its expected increase in taxable wealth.

When oil was found at a given point on the floor of the Red River valley four chief questions arose, as follows: Does the land belong to Texas or does it belong to Oklahoma? If it belongs to neither, then it must belong to the north shore riparian owners, including a large number of Indian allottees, or to the United States, or in part to one and in part to the other.

The Boundary Treaty with Spain

There were added to the whole question certain complicating elements due to the Treaty of 1821 between the United States and Spain, whereby there was established a boundary line between the Spanish possessions and those of the United States along the southern bank of the Red River. The bearing of this episode upon the question in hand is made clear by a brief examination of certain historical facts.

When the United States acquired the Louisiana Purchase in 1803 the limits of that tract were not clearly defined. Various disputes followed as a matter of course; the dispute with Spain was concerned chiefly with the Sabine, Red, and Arkansas Rivers. The course of the Sabine (which now forms part of the boundary between Texas and Louisiana) was agreed to; *the eastern bank and all the islands* going to the United States, the western bank to Spain. The settlement of the boundary on the Red was reached only after protracted and at times delicate negotiations between John Quincy Adams, then Secretary of State, and Sr. Onis, the Spanish Minister. It was agreed in this case that the southern bank was the boundary and that *not only the river but all of the islands* were the property of the United States. The text of the treaty is not altogether clear on the matter of the southern bank; but its meaning is unmistakable upon reference to Adams'

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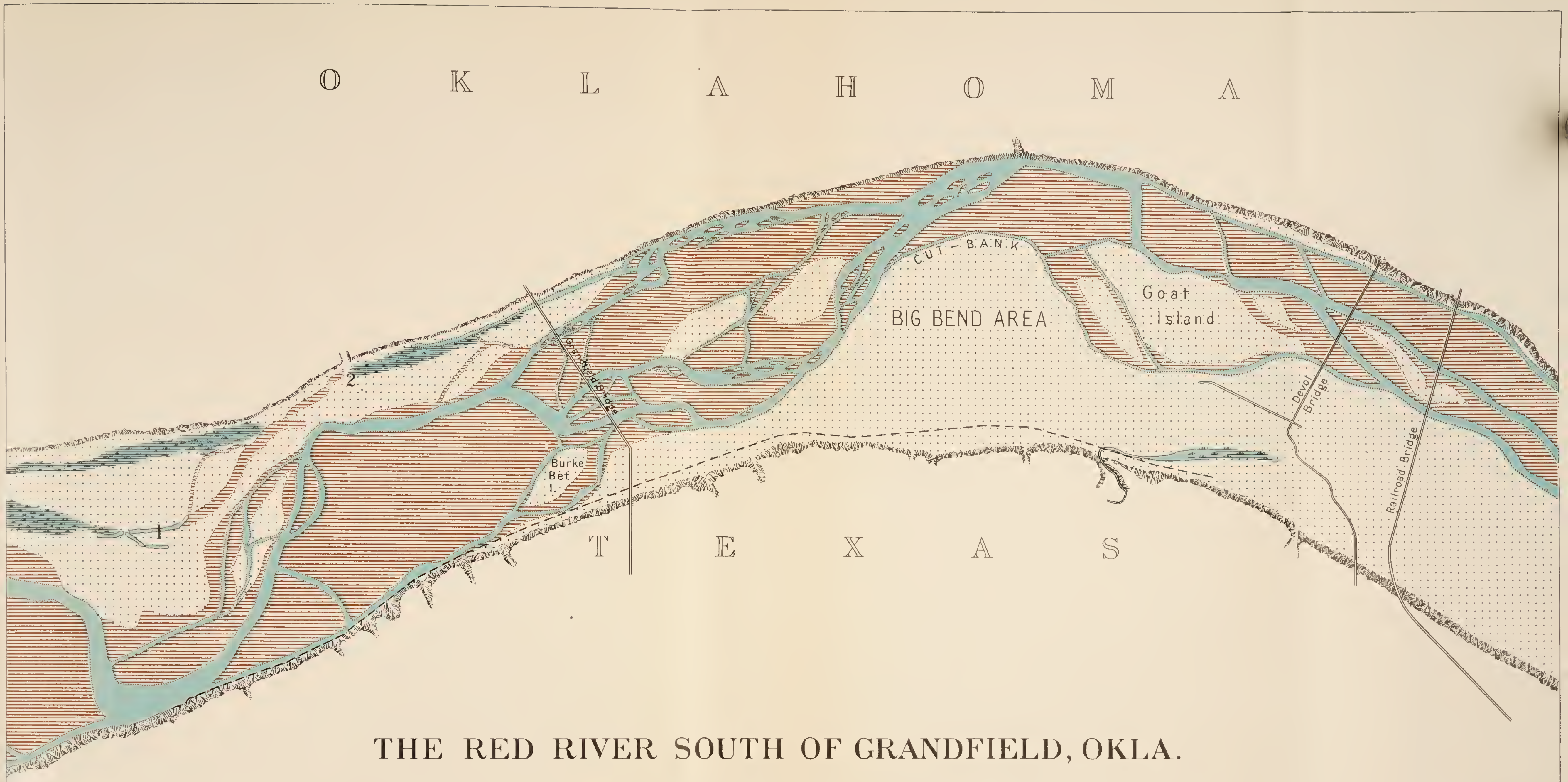
[2] This was one of the grazing reserves created under the Act of Congress of 1900, for the common use of the Indian tribes. The creation of the grazing reserves was part of a plan of terminating the great general Indian reservation established by treaty between the United States and various Indian tribes in 1867. The grazing reserve itself was terminated in 1906.



THE RED RIVER SOUTH OF GRANDFIELD, OKLA.

▨ Low-water channels, December, 1919.

▤ Exposed bed of river at low water.

⬚ Sand-drifts, flood-plains, islands, and terraces of the valley floor.

– – – Southern border of U.S. Supreme Court receivership at the Big Bend

(After a map by R.W. Livingston of the General Land Office)

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The Geographical Review, Vol. XIII, No. 2, 1923, Plate I

diary, which paralleled the whole course of the negotiation.[3] There was reserved to Spain the right of access to and use of the river for navigation, commerce, and the like. The line was never monumented by a boundary commission; and jurisdiction, though conflicting in practice, was divided between Texas and Oklahoma without serious trouble until the discovery of oil.

Two Principles of Settlement

There are two general ways of approach to a settlement under the historical and geographical conditions surrounding the Red River boundary question: (1) to establish the line in accordance with the prior rule of the court in similar cases, (2) to follow the river's course as of the date of the treaty.

In this instance the court declared in favor of the latter but seems as a practical matter to have followed the former method. It observed the river indirectly, through the maps, photographs, and testimony of expert witnesses; reviewed the trend of testimony and judicial decision in similar cases; and decided that the conclusions based on the known method and rate of operation of physical agents were "speculative" and did not form a reliable basis of judgment. As a matter of fact, this expression is not precise. While the scientific testimony was often not speculative, at the same time it was not and could not be sufficiently definite as to the *time* in which river agencies act in producing a given result to be a sound basis of judgment.

The second method of approach—the tracing of the course of the river in 1821, or 100 years ago—does not lead to a convincing conclusion. To establish an older position, a survey of that time is required or at least a sketch map bearing a great amount of circumstantial detail; and to this we must then add the judgment of a physiographer as to how and when the river changed its course; or we must take the judgment of an ecologist based, among other things, on a study of the age of trees as shown by their rings of growth. Let us take the first or purely physiographic question and see its relation to the law. Take for granted a given position of the Red River in 1821. The court would then require proof that every change in the 500 miles of boundary had been brought about in one of two possible ways: (1) by *erosion and accretion* or (2) by *avulsion*. What do these terms mean and how do they affect boundary location in law?

In a large number of cases it is recognized that a stream, particularly one like the Red River, may shift its bed by erosion of the confining banks upon the one side and (or) by deposition upon the other. The riverward growth of the inner bank of a meander illustrates the process of growth known as *accretion*. When it takes place there is of course a shifting of the river from one side to the other. At a given bend a farm on one side of the river is increasing in acreage by accretion just as a farm on the opposite side may be diminishing in acreage as a result of erosion. The law has long recognized that such a change, if on a boundary, *carries the boundary with the river,* whether that boundary is between property owners merely or between states. A moment's reflection on the difficulties of administration and land survey that would follow if an opposite course were taken confirms the wisdom embodied in this rule of law.

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[3] American State Papers, Foreign Relations, Vol. 4, pp. 253–256, 530, and 622.

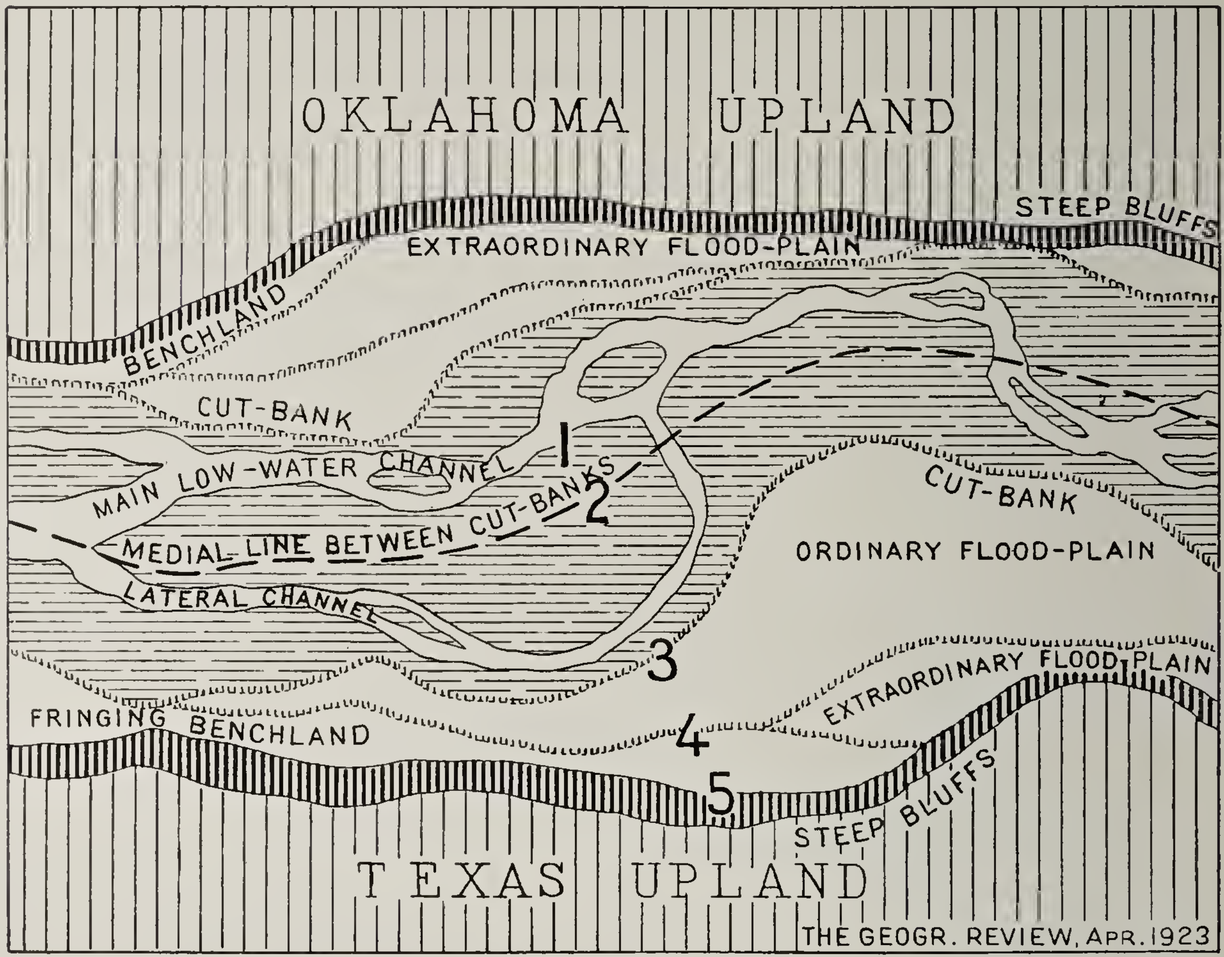
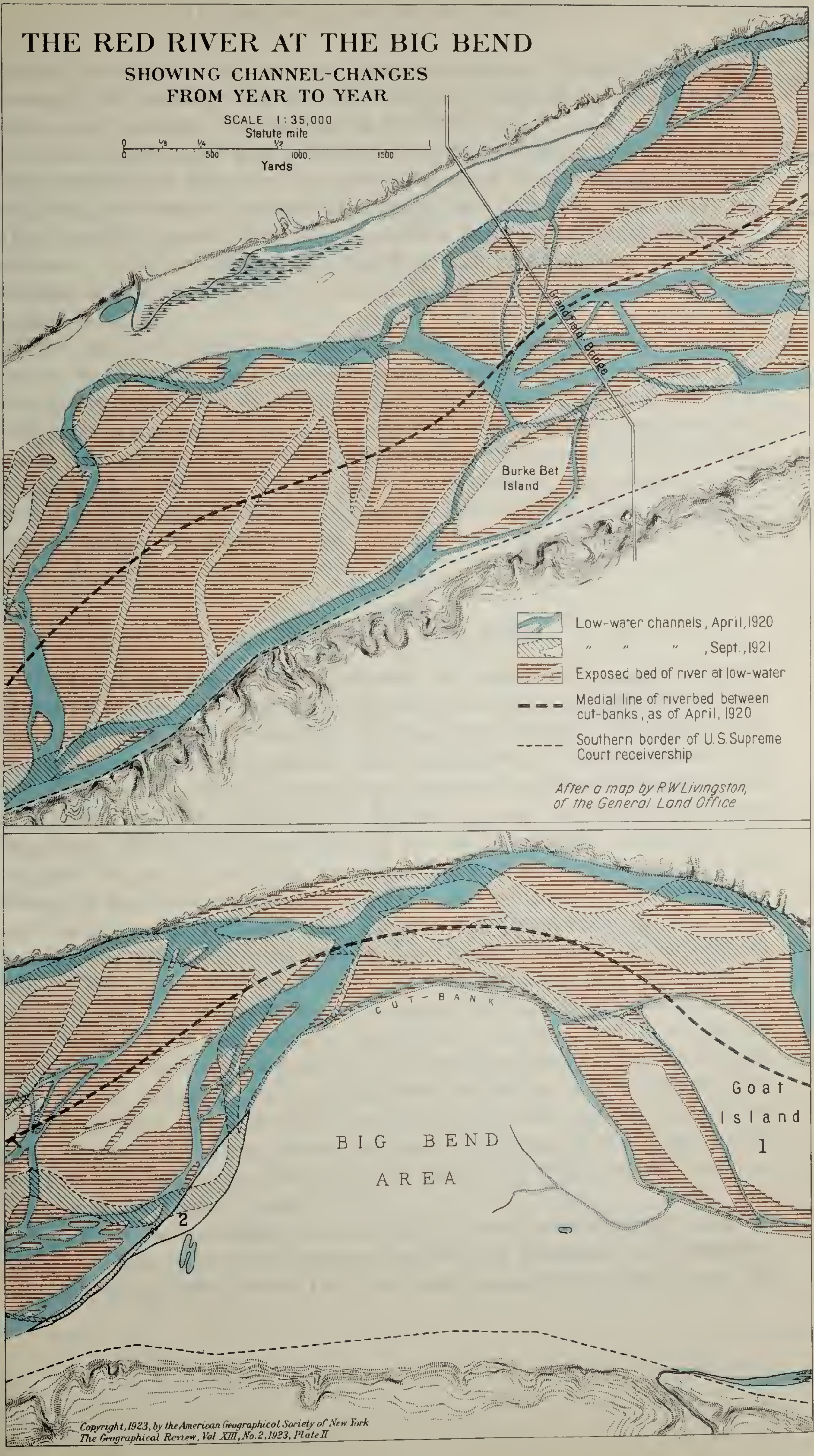


FIG. 3—Composite sketch to show physiographic conditions on the Red River in relation to the Texas-Oklahoma boundary settlement. The Supreme Court has fixed the cut bank (3) as the boundary between the two states. Texas claimed the valley floor northward to the southern edge of the main low-water channel (1). The United States and Oklahoma sought to have the steep bluffs at the southern edge of the valley made the boundary (5). Some of the experts argued for the edge of the benchland or, where present, the extraordinary flood plain (4) on the ground that this would ensure reasonable stability. The ordinary flood plain is channeled, dotted with wind-drifted mounds of sand, and subject to frequent overflow. It is sometimes cut off by avulsion from neighboring fast land and its cut bank is subject to rapid erosion or displacement in every flood. As the cut bank changes so does the medial line (2). The medial line is a property line, not a political boundary. The United States owns the southern half of the bed of this unnavigable stream, and the riparian owners in Oklahoma the northern half. There are two classes of islands: 1, those that lie in the low-water channels as indicated above; 2, those that lie between these channels and the cut banks and are "surrounded by water" during normal and extreme high stages of the river.

On the other hand, it is well known that meandering streams not only enlarge their meanders but that this enlargement in time causes a cut-off across the necks of meander lobes. In such cases the cut-off takes place almost universally at time of flood. When the flood subsides the river is flowing in a new course, and its old course is left in some cases several miles to one side and at a distinct and easily recognized distance. This and similar


SCALE 1:35,000
Statute mile
0
1/8
1/4
1/2
1
0
500
1000
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Yards
Grandfield Bridge
Burke Bet Island
Low-water channels, April, 1920
″ ″ ″ , Sept., 1921
Exposed bed of river at low-water
Medial line of riverbed between cut-banks, as of April, 1920
Southern border of U.S. Supreme Court receivership
CUT-BANK
BIG BEND AREA
Goat Island
1
2

THE RED RIVER AT THE BIG BEND

SHOWING CHANNEL-CHANGES FROM YEAR TO YEAR

After a map by R W Livingston, of the General Land Office

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The Geographical Review, Vol XIII, No.2, 1923, Plate II

changes in the course of a river are known as *avulsion*. When it occurs on a boundary *the boundary does not follow the river*, as in the previous case of erosion and accretion, but remains in its old position.

In a river such as the Red where there are many changes at low water and many threads and belts of swift water at times of flood it naturally follows that both processes are present to a degree and that they grade into each other in such a manner that their separation becomes impossible in certain instances. Also in a stream like the Red both processes may be violent; whereas, in general, avulsion is violent, and accretion is termed "slow and imperceptible."

Were the bank formed upon rock and virtually unchangeable from century to century the location of the bank in 1821 and the location of the bank today would vary so little and the changes that had taken place would have been so gradual and often so obvious that the location of the boundary in our time would be a matter of no difficulty whatever. On the contrary, the cut bank of the river is made almost everywhere of loose material, easily eroded, and constantly shifting from side to side; and many changes of great magnitude have taken place in the position of the river and of the cut banks and of the contour of the bed, since 1821.

The Testimony of the Trees

The Court appears to have abandoned the attempt to interpret so complicated a history with precision, involving, as it does, changes in the river since 1821. Nor could it find sure footing in the ecological testimony, vast in amount and detailed in quality, that was submitted for its examination. The Court went so far as to say that "there are inanimate witnesses, such as old trees, which tell a good deal." Because a pecan, one of the trees at the "Big Bend" (Pl. I), in the most critical part of the disputed boundary, had attained an age of 170 years, the Court took that fact to mean that the whole Big Bend district was over 100 years old and felt it unsafe to conclude with certain of the ecologists that the tree had grown upon an island that had become attached to the mainland by avulsive action and subsequent filling. The Court would not even go so far as to say that the river had surely flowed in a more southerly position. It stated that "the river or a channel may have been there in years that are gone; but, if so, no one knows when." It had been expected that the Court would recognize the convergence of ecological and physiographic testimony which showed that certain portions of the lower or ordinary flood plain had been formed so recently that even in the absence of human testimony it was quite safe to say that the changes occurred since the date of the treaty of 1821 between Spain and the United States.

Had the Court accepted this principle it would naturally have been required in some cases at least also to lay down a boundary line separating river effects produced before 1821 and those produced after that date. So fine a distinction the experts could not agree upon making, even among themselves; and if they could not agree the Court could not accept the principle upon which they were working as a basis for its own decision, for the judgment of the Court with respect to the evidence of the trees could not be supposed to be sufficiently refined to give it an advantage over one group as opposed to another group. There appeared to the Court to be only one way out of the quandary, and that was to discard the ecological evidence as to the youth of the land and take the age of the oldest tree.in a given district, to represent the minimum age of the *whole* district, and not a part of it only.

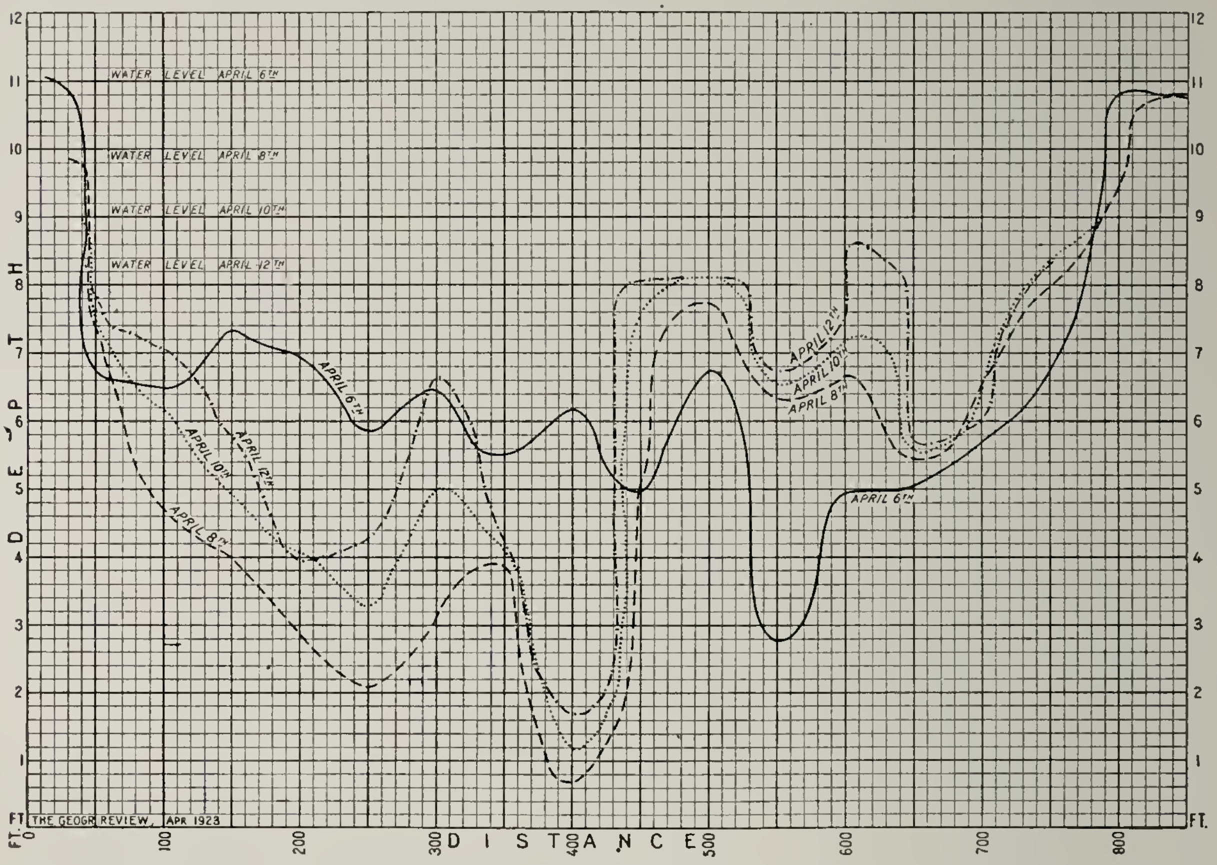

FIG. 4—Changes in the form and depth of the bed of Red River as determined by soundings at the Grandfield Bridge during different stages of a given flood, 1921. The whole mass of sand beneath mean high water is reworked by the river in successive floods and in different stages of the same flood.

THE TEXAN POINT OF VIEW

We have not exhausted the list of troublesome factors that have made the Red River boundary the most complicated one that has ever confronted the Supreme Court of the United States. There remains the question of the State of Texas itself, how it originated, and its special status in the American Union. It will be recalled that, peopled largely by pioneers from the United States, it became an independent republic after a war with Spain in 1836 and that upon its own appeal it was admitted to the Union and is referred to as the Lone Star State because of the device on its flag when it was a republic (1836–1845). The people of Texas have never forgotten their early history. It was not merely the common problems and dangers of pioneer days that welded them into a strongly self-conscious community; it was also the struggles and suffering of their own war of independence. The date of the Battle of the Alamo, March 6, 1836, and not the 4th of July, is the celebration that arouses the greater enthusiasm. Local histories abound, and there is a certain sense of detachment from the rest of the United States and of pride in the imperial extent of the state not characteristic of any other American state. Though entitled by Act of Congress to be broken up into not more than four states, the great domain of Texas has been kept a unit.

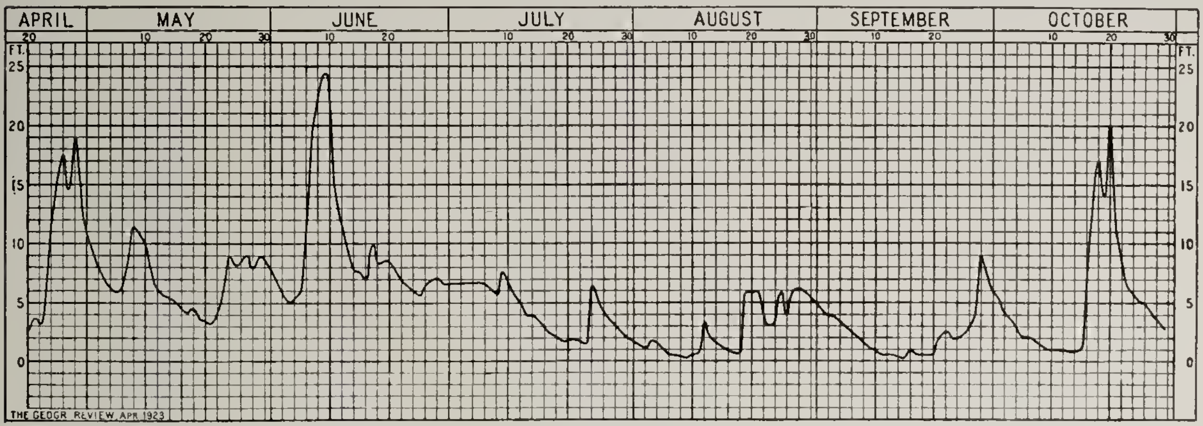

FIG. 5—Gauge readings on the Red River at Denison, Texas, from April 20 to October 30, 1915, after a drawing by the War Department. Included in this period are all the rises in the river for that year except two, the first a rise of 7 feet on March 4, the second a rise of 5½ feet on April 11. By reference to Figure 2 it is seen that Denison is on the lower river. Rises of 10 to 15 feet in twenty-four hours occur several times a year. In the upper river the rises are not so high, but the lateral spread of the stream is proportionately greater. See Plates I and II and Figures 7 and 14.

It is easy to understand, therefore, that the question of the Texan frontier and of the loss or gain of land is a matter of far keener interest to the Texans than similar questions are to the people of other states. It is a matter of economic interest to them as well, for by the terms under which Texas was admitted to the Union her unappropriated public lands were left in her possession, to be disposed of according to her own will, and did not become a part of the public lands of the United States or subject to their administration under the homestead or mineral laws. The state itself has granted patents for the occupation of its empty lands; and it is the state, not the national, treasury that has benefited correspondingly. Though Texas had long administered a great tract between the Red River and the so-called North Fork of the Red, the Supreme Court decided against permanent possession by a decision handed down in 1896. So that the interest of the Texans in the Red River dispute was intensified through the disappointment that followed its earlier loss. In 1920, when the oil dispute was at its height, Texas militia was sent to the Big Bend, land was held in some cases by intimidation and force, and "armed conflicts between rival aspirants for the oil and gas had been but narrowly averted."[4]

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[4] U. S. Supreme Court, decision of May 1, 1922, p. 2.

The Habits of the Red River[5]

The source of the Red River is in the Llano Estacado, or Staked Plains, of the panhandle region of northwestern Texas. These plains lie at an elevation of three to four thousand feet above sea level and are exceedingly flat. Here and there are shallow depressions, and in some of them permanent or semi-permanent waters have gathered. It was long a ranching country, and the land was held in estates of princely extent. In the absence of permanent water over much of the area, wells were drilled to obtain water for the stock. The windmill made an early appearance partly because of the exceptional depth from which the water was drawn and partly because the wind blows unobstructedly over the great expanse of flat land and can readily be harnessed to the task. One of the residents said to me, "Some people complain about the wind, but I think we should be grateful for it. We could not live here without it. It waters our stock."

There is a definite eastern margin to the High Plains, a very jagged border known as the "Breaks." The smooth floor of the plain here terminates in a bold scarp which falls several hundred feet to the level of the lower plains to the east. To the people of the region the High Plains are simply "the plains," and the lower country, even where it is locally as smooth as the High Plains, is known as "the prairies." Everywhere the High Plains are covered with grass, except where wheat fields are cultivated. There is no natural

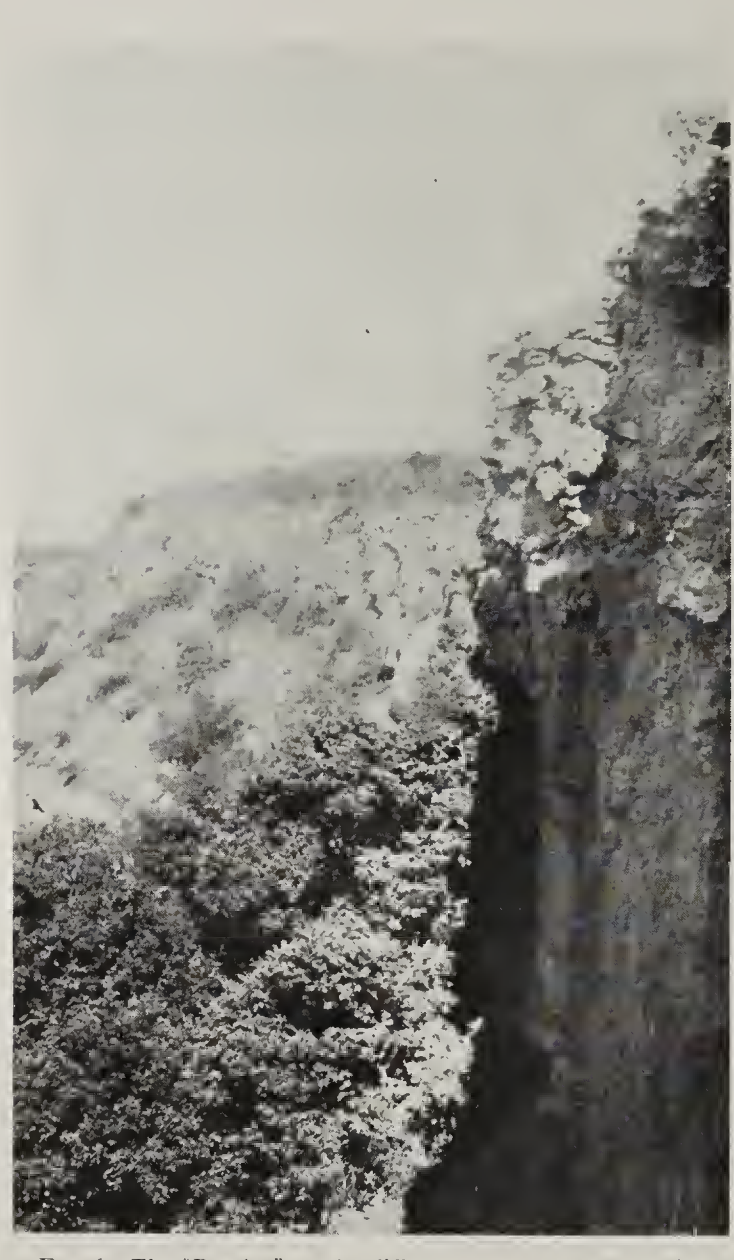

Fig. 6—The "Breaks," partly cliffed and everywhere prominent eastern margin of the High Plains of northwestern Texas where the Red River takes its rise.

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[5] The following description of the Red River is based on a study, by the author, of the region between the High Plains and the western boundary of Arkansas in 1921 as physiographic expert appointed by the United States Department of Justice.

growth of timber. To the rugged aspect of the Breaks there is added the color of patches of woodland and chaparral. Here grow juniper, elm, cottonwood, and mesquite. Eastward from the foot of the Breaks there is also a local timber growth, in the draws, or small tributary ravines, on the walls and floors of box canyons, along the foot of bluffs of any sort where the ground water oozes out to make a belt of better-watered country that sustains, besides trees, a luxuriant growth of grass. All game has vanished from the High Plains. The land is everywhere fenced off for ranches or wheat farms, and the country has an occupied appearance. One is almost never out of sight of a house. The Breaks harbor wild game, and such hunting as is still done in the region is done here. They are many miles in extent from north to south and several miles in width, and the broken character of the narrow belt makes habitation virtually impossible. On the other hand, the prairies are everywhere occupied by farms and only locally by ranches. Such is the scene in passing from the sources of the Red River down to the point where it becomes a boundary between Oklahoma and Texas (100th meridian, Fig. 2).

A multitude of headwater ravines and box canyons in the Breaks at the border of the High Plains are gathered into two main tributaries, Tulia Creek and Prairie Dog Town Creek, which together form the Red River. These headwater tributaries flow over sandstone and, except in wet weather, are clear-water streams until they pass the Breaks and enter the prairies. From this point on, an almost infinite number of ravines are gathered into tributaries which, flowing over soft "Red Beds" detach vast quantities of alluvial material and deliver it to the trough of the Red River. The Red River takes on a very special character from the point near the edge of the Breaks where this alluvial material is dumped into its channel. The alluvium is so soft that the cloud-burst type of rainfall gives the river a very irregular character. It takes from one to seven days for a "rise" to run its course, and the sum total of rises in a given year seldom exceeds forty days in duration. The vast quantities of soil flung into the river at times of rise are in contrast to the absence of waste delivered to the river in the intervening dry season.

Hundreds of tributaries, large and small, may be filled with violent waters in times of heavy rainfall. In a night the river may double or treble its volume as a consequence of far-distant rains or cloud-bursts at the sources of the streams in the Breaks at the edge of the High Plains. When the supply ceases the main stream contracts from a flow in places two miles in breadth filling the whole floor of the valley to a tiny stream that can be forded on foot without the water's rising more than a few inches above the ankles; and in exceptional years the Red River may disappear altogether in the upper parts of its course, enabling one to walk from side to side dryshod.

In times of flood not only does the river carry along the matter left suspended everywhere in the period of drought but also shifts its whole bed for a distance of many feet. The pore spaces in the light sands of the river bed are filled with water in times of flood, and the whole bed becomes a semifluid mass moving slowly downstream. In years of exceptional rainfall violent changes take place in the course of the river. The current, impinging upon a bank, detaches great quantities of material, to fling it into the stream, whence it is deposited in the form of sand bars farther down. Cut-offs take place not only across the necks of meander lobes but also upon any mass of flood-plain material where the waters may be directed into remnants of older channels or scourways. In the course of a hundred years the river will have changed its position an almost infinite number of times.

As a consequence of the flashy character of the river and the quantities of earth dumped into its bed the volume of water is never long adjusted to the burden of waste. The river has hardly started upon a task when its volume is either increased or diminished. The result is that what the river built an hour ago in the form of sand bar or bottom channel is not adapted to the volume of water that now flows past these features. So from day to day the river finds itself compelled to change the *form and position* of the materials upon which it works or rather with which it struggles. During the long dry spell the currents of the low-water streams show many advances in the process of becoming adapted to the volume of water, the texture of the material, and the gradient of the channel. The next rise sweeps away the results of all these systematic endeavors. The river is almost constantly in a misfit relation to its curves.

If we have in mind this picture of the river's embarrassed flow in the upper part of its course we are able to appreciate the statement that the Red River is here not a single river but a succession of many rivers. Now it is as tiny as a meadow brook flowing lazily through an eastern field, and again its volume is as great as that of the Colorado. Its gradient in places is that of the Colorado, namely, 7 feet per mile (e.g. west of the Big Bend), and its turbulence at times of extreme flood is such that a rowboat could not live in it.

The accompanying sketch (Fig. 7) shows the character of the river when broken up into separate channels. Its appearance is then that of a typically braided stream (Pl. II), much like the Platte in Nebraska, the Majes in Peru, and many others. Figure 14 shows it when it has been reduced to a single thread with a very feeble flow, and Figures 20 and 21, Pl. III, show it at flood stages when it fills the whole valley floor from bluff to bluff and assumes almost incredible proportions.

Complicating the physical geography are the diverting effects of the wind. On days of high wind one may see the whole region enveloped in a cloud of fine dust which penetrates everywhere. The clouds have such blackness and the wind is so violent as to produce a terrifying effect. "Cyclones" (really tornadoes) are not uncommon; and cyclone cellars have been built, partly underground, adjacent to every house. They are used not so much in times of the infrequent tornadoes as in times of the frequent dust storms. Even when winds blow with less violence a vast amount of work is done upon the valley floor. Thousands of tons of dust are picked up and blown about so that the whole valley to the level of the upland is filled and from above has the appearance of a broad river of dust. At such times also great quantities of the lighter and finer sands are blown along the surface to lodge in the lee of obstructions of every kind whether natural or artificial and to extend and change the shape of sand dunes and irregular ridges of sand gathered by earlier winds.

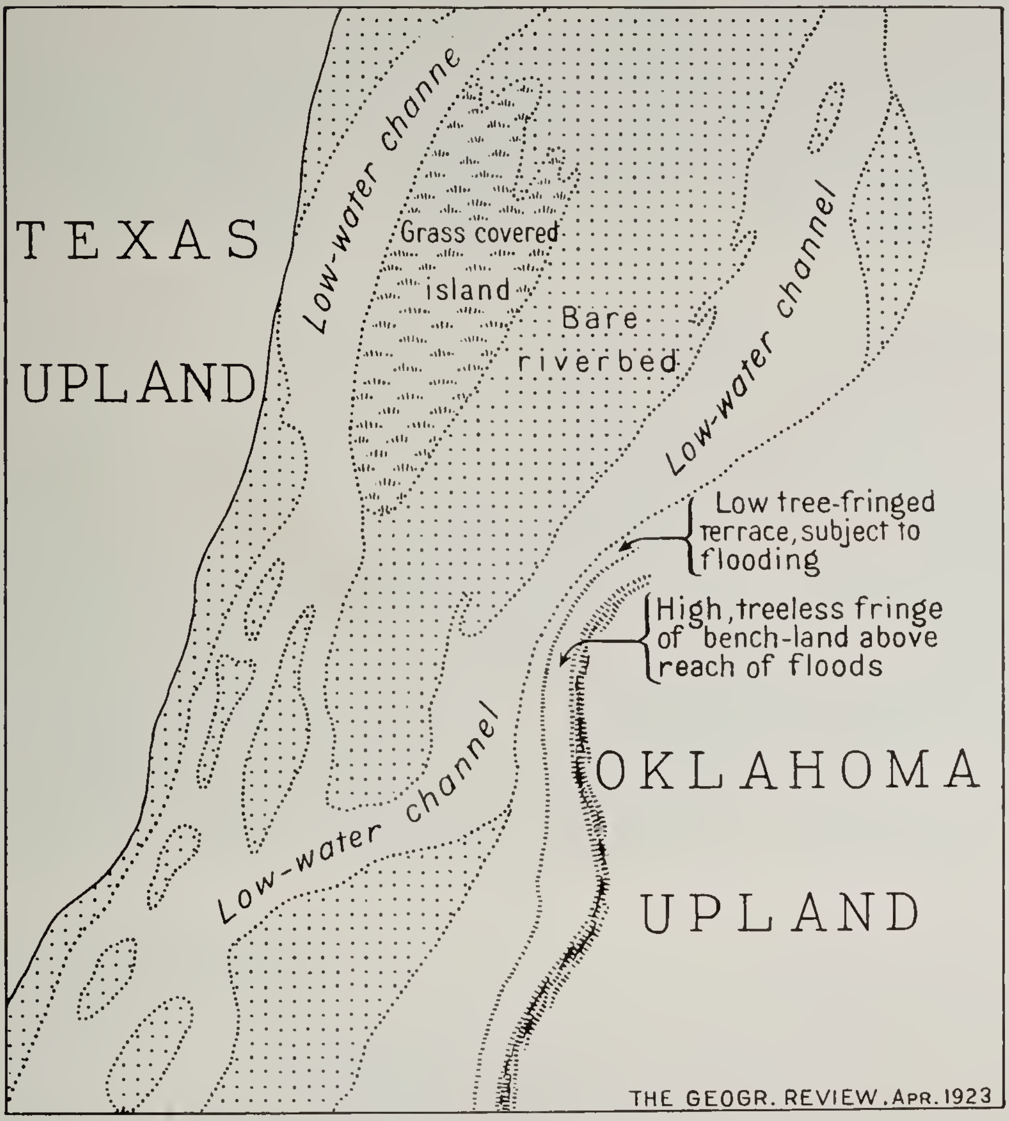
TEXAS
UPLAND
Low-water channel
Grass covered island
Bare riverbed
Low-water channel
Low tree-fringed terrace, subject to flooding
High, treeless fringe of bench-land above reach of floods
Low-water channel
OKLAHOMA
UPLAND
THE GEOGR. REVIEW. APR. 1923

FIG. 7—The Red River in detail northwest of Terral in Jefferson County. The sketch is oriented like a map. It illustrates the braided pattern of the stream in falling stages. During floods or so-called "rises" the river flows bank full, and at extreme stages even the grass-covered island is submerged.

Naturally these sand accumulations are located in the lee of obstructions. They are scattered everywhere on the dry bed of the river in the upper section and are best developed above and below the 100th meridian. They line the river banks and channels of every sort whether those of low water or of high water. Thus to the changing effect of the river in its flood stages there is added the constant remodeling and building effects of the wind as it shifts the surface material about and clogs channels new and old, turning the waters on their next rise this way and that as they strike the dunes.

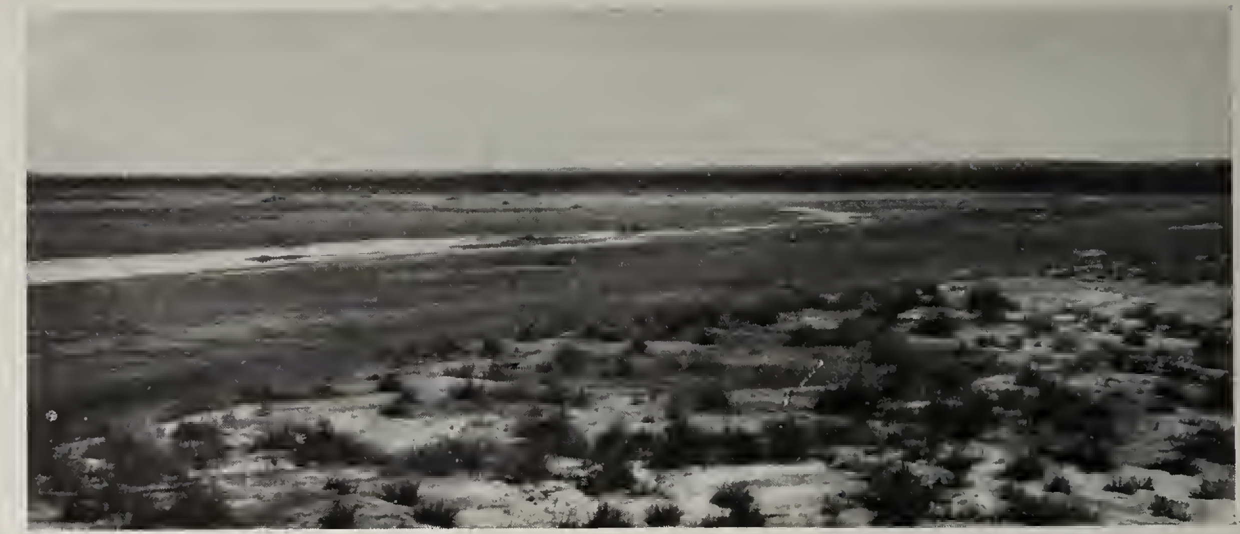

Fig. 8

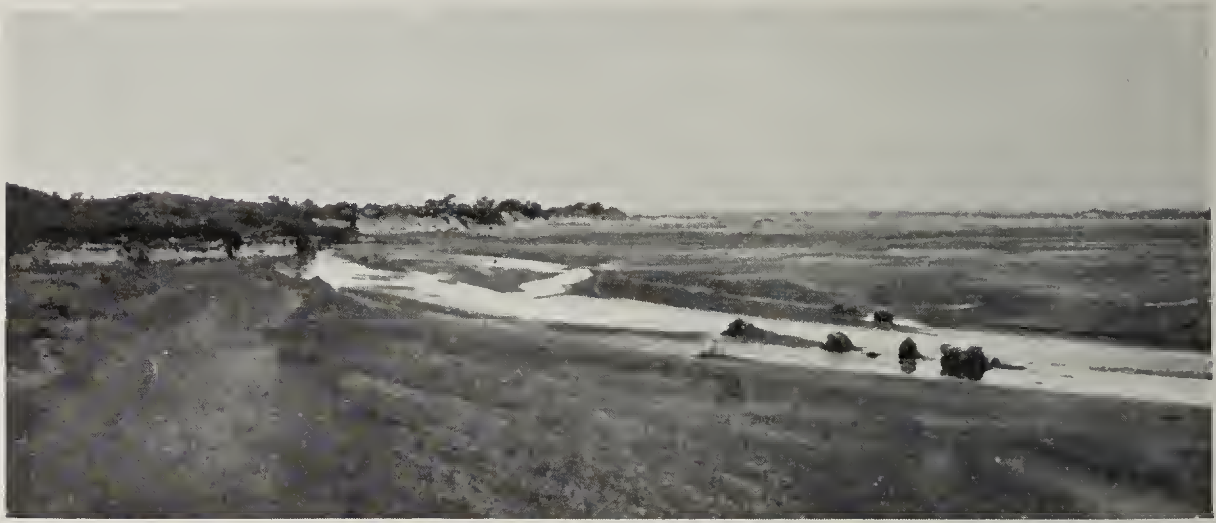

Fig. 9

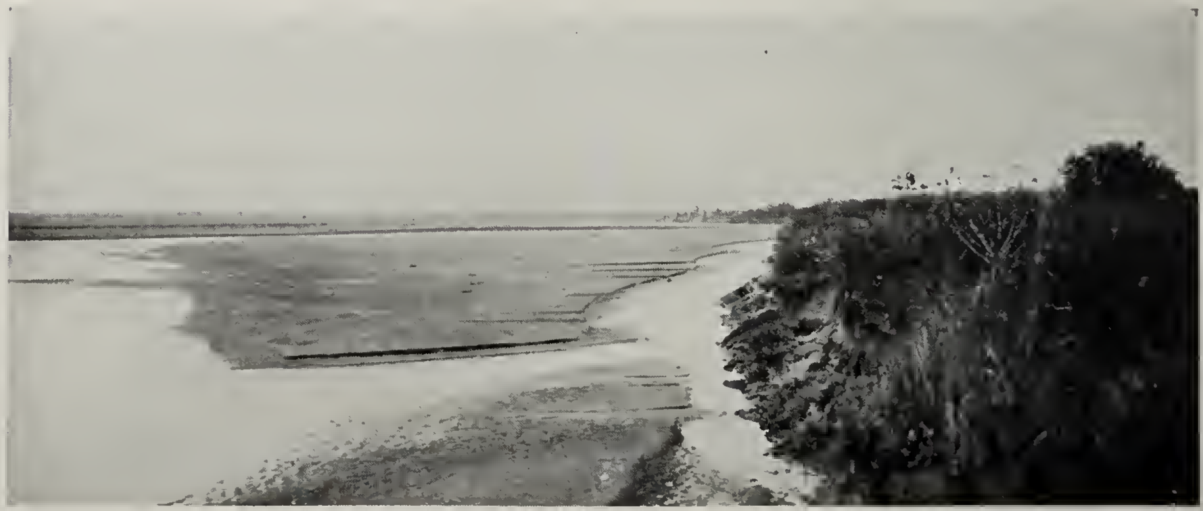

Fig. 10

Figs. 8-10—The nature of bed and banks in the upper portion of the Red River. Figure 8 shows the Little Red west of the 100th meridian, one of the main headwater tributaries of the Red River. Its bed and banks repeat the features of the Red, and its heavy load of waste is typical of all the rivers which, like it, flow over the Red Beds and other soft sedimentary layers, detaching vast quantities of waste for delivery to the bed of the Red River. In Figure 9 are shown the low cut banks of the Red just east of the 100th meridian formed on loose sand drifted into place from the exposed bed of the river at low water. The bare and channeled bed is typical. Figure 10 shows the cut bank as it appears looking east from the southern end of Grandfield Bridge; and the heavy sheet of sand left in the river bed as the water subsided after a flood.

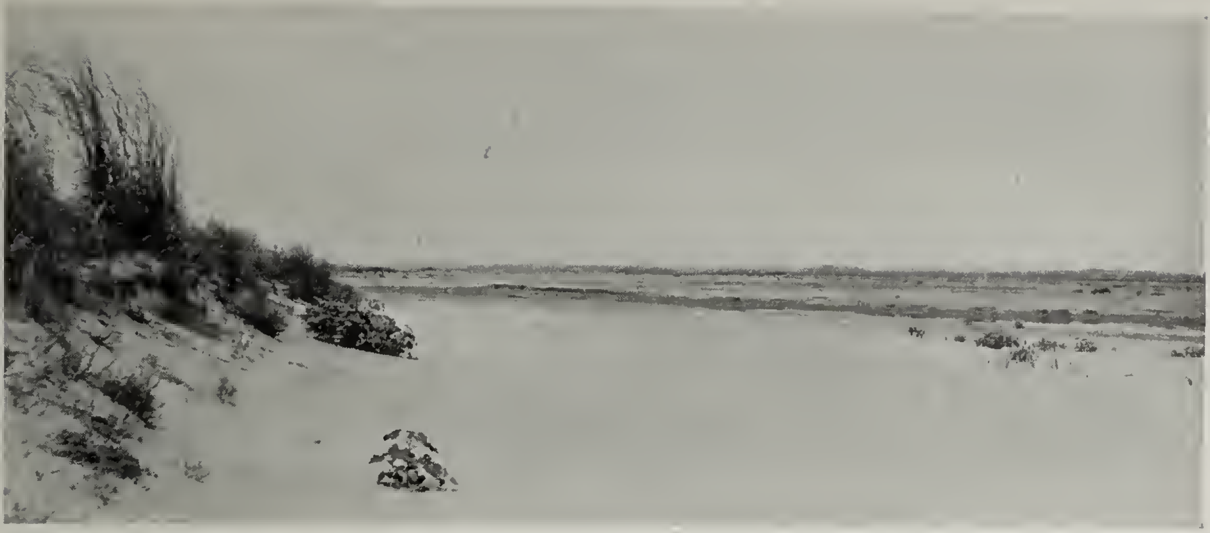

FIG. 11

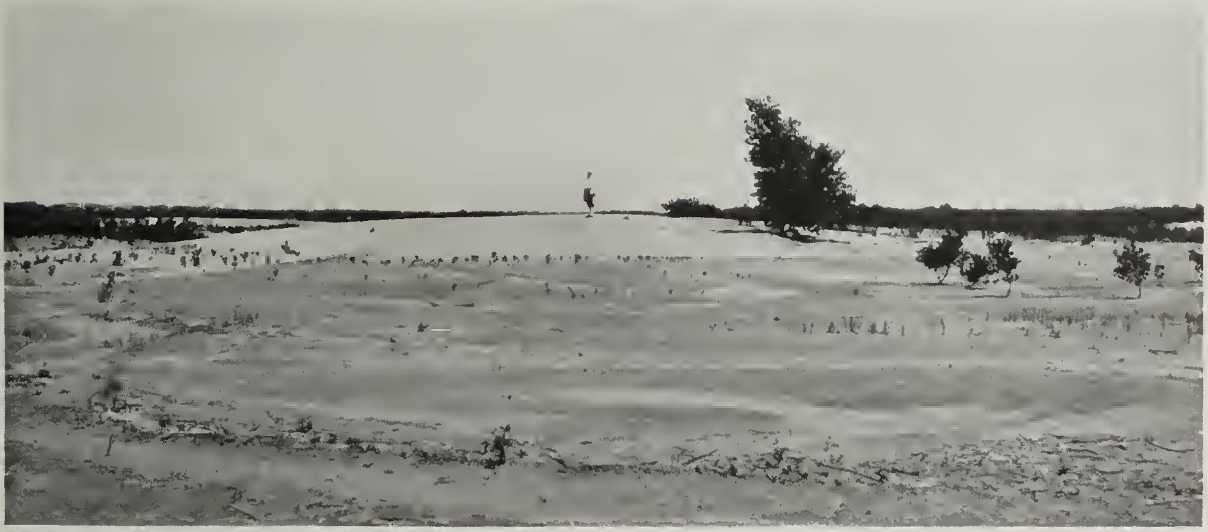

FIG. 12

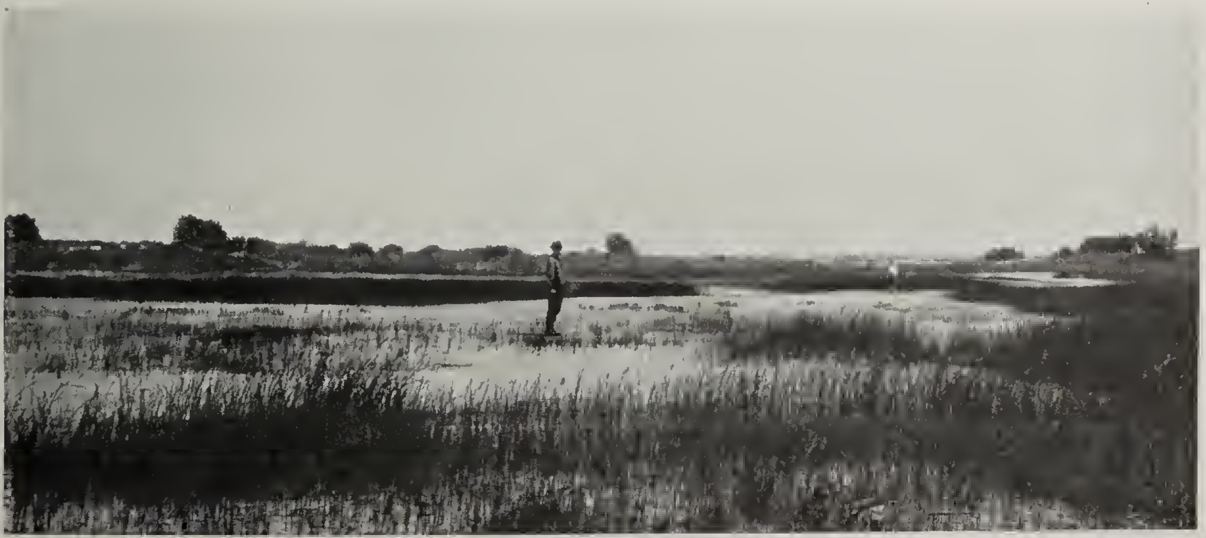

FIG. 13

FIGS. 11–13—These three figures illustrate wind effects upon the bed and banks of the upper section of the Red River between the Big Bend and the 100th meridian. In Figure 11 light sand is seen blown against the low cut bank. Contrast this bank with that shown in Figure 18. In Figure 12 the wind has raised a high mound which will obstruct or deflect the waters of the next flood and may become a more or less permanent island. In Figure 13 the wind has blown sand into a marshy lateral channel way partly choking it and modifying its contour. Figures 12 and 13 illustrate how islands are sometimes formed and the river deflected into new courses on the low flood plain. The combination of these effects is carried so far in some places as to tie an island to the firmer benchland (Fig. 3).

As we descend the five hundred miles of the river forming the boundary between Texas and Oklahoma the signs multiply that the river gains in its power over the waste on its floor. The river curves become more regular, and halfway down through the disputed zone they take on the pattern of a normally meandering stream, with toe caps, meander cut-offs, flood-plain lobes, steep outer banks, gradually shelving inner banks, and broad flood plains and terraces on either hand. Also as we proceed downstream the number of tributaries entering the river increase, and many of these (e. g. Washita, Kiamichi, Wichita) have their sources not in the dry High Plains with a cloud-burst type of rainfall nor even in the Breaks where springs occur but out upon the prairies where the rainfall is more nearly of normal type and where seepage from the ground water is one of the main sources of water supply. It follows that the river is no longer subject to the irregular forces of the headwater region, but has a dependable supply of water and is more regular in its flow. When floods occur there is still a great rise of water. At Denison, for example, the river has been known to rise thirty feet as measured on the bridge pier. When the floods subside the river does not contract to a mere thread but retains the proportions of a true river and, so to speak, resumes the regular work that is only interrupted by the floods.

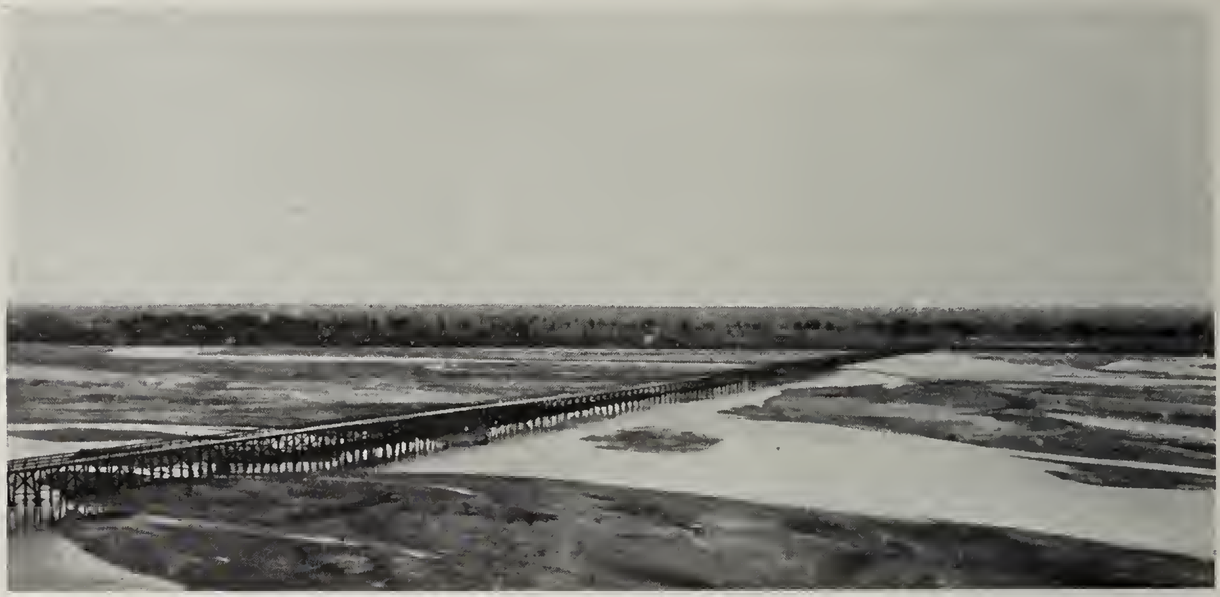

FIG. 14—The Upper Red River bed at low water at the Electra Bridge in the northwestern corner of Wichita county looking northward from the Texas bluff toward Oklahoma. For location see Figure 2.

Where the river is most subject to change, as in its upper course, the locations of its banks also change from flood to flood. The evidences of such change are everywhere, and the local records and traditions are full of instances that have affected the welfare of the communities along the valley. There is no definite break between the upper and lower sections, between a stream subject to the vagaries of wind and flood and a stream in masterful occupation of its valley floor. The change is gradual; and here and there the characteristics of the upper section appear in the lower, but of course to a more limited degree. For purposes of reference we may take the middle of the disputed zone as the dividing point into upper and lower sections.

The Red River Is Really Many Rivers in One

Almost all rivers vary in regimen. They have seasons of high water and seasons of low water. They are broad at flood time and relatively narrow at times of low water. What matters to the people of a given valley and what matters in a boundary dispute is the *degree* to which such changes occur. In the more densely inhabited regions of Europe and North America the rainfall is fairly evenly distributed throughout the year, and there is only moderate variation. It results that there has been developed a terminology and even a body of legal decisions which are adapted to rivers of the type we call normal but not to those of an extreme type, such as the Red. In the Southwest generally, as in Mexico, the Spanish language has furnished resources for the detailed description of natural features, and terms thus applied come to have fairly exact meanings. Travelers who return from the deserts of inner Arabia and from the vast desert spaces of the Sahara describe the features of ravine, valley floor, and sand drift, in local rather than our accustomed terms because these are used in more precise and specialized ways.

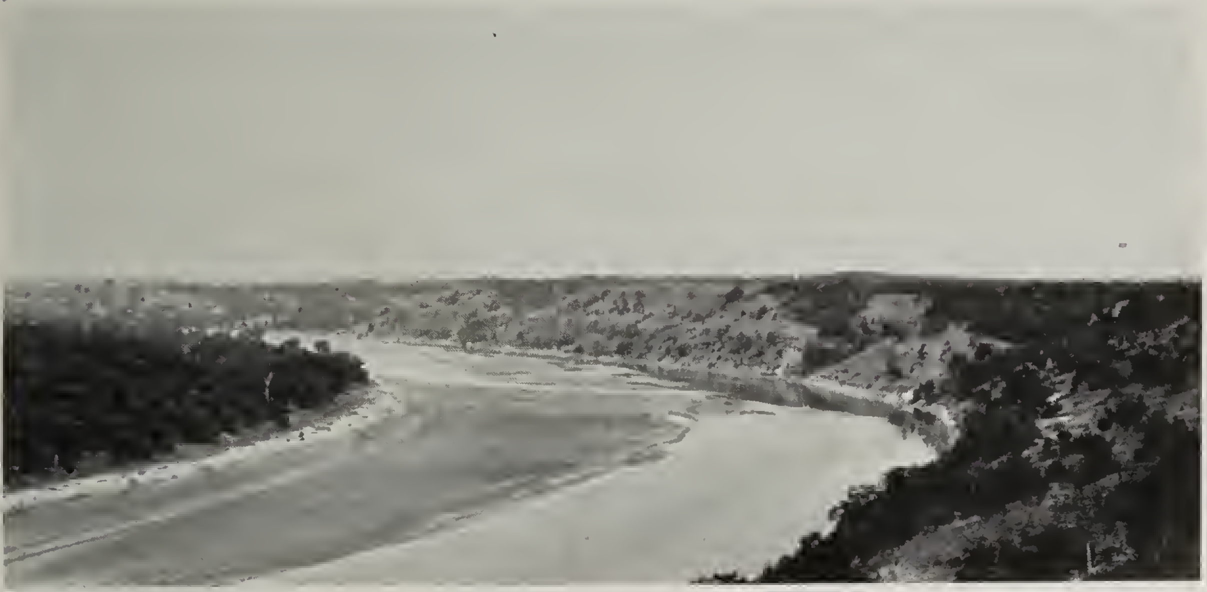

FIG. 15—Looking west at the tip of the Horseshoe Bend east of Bomar, Love County. On the right is Oklahoma. The river here flows through limestone. Like Figure 17, the photograph shows the definite character of the cut bank in the lower river as contrasted with its indefinite character and changing position in the upper river.

Since the Red River rises in one climatic region and flows into another, it is one river in its upper course and quite another in its lower course. When the Supreme Court tries to frame a decision that will fit 539 miles of river course in such a case it is precisely as if it tried to frame a decision which should apply equally to a river in western Texas and another river in Ohio. This cannot be done, and to this extent the decision of the Supreme Court with reference to the boundary between Texas and Oklahoma will be a subject of debate and of litigation for years to come, though it will settle momentarily the immediate question as to who owns the oil and the ranch lands and the plantations along the valley floor.

A Stable Versus an Unstable Bank

A large volume of testimony had to do with the question of a stable or permanent bank, and this made it possible for both experts and counsel to exhibit *a wide range of opinion concerning stability or relative stability* and the use that the Court would probably make of this principle in locating the boundary. As a matter of fact, the term "stable" does not occur in the final decision. The Court seems to have set entirely aside the principle of stability and the chance it offered to reduce the volume of future litigation. It confined itself to the question of the location of the bank in the ordinary and accepted use of the term.

In order to show the bearing of this decision and its relation to the expert testimony, Figure 3 is introduced. Number 1 in that figure indicates the decision sought by the United States as intervener in the case. Oklahoma asserted ownership of the bed of the river as well as jurisdiction over its surface waters to the south bank, setting up the claim that the river had been navigable at one time and was now navigable in the sense that it *could* be navigated (p. 165); whereas the Court ruled that the river was not now navigable in fact, was not being navigated, and therefore that title to the bed of the stream did not pass to Oklahoma on her admission to the Union.

It is obvious on even a superficial inspection of the region that the cut bank on the border of the river bed is the most natural boundary from the standpoint of the actual residents.[6] Ranches and farms, cemeteries and schoolhouses, churches, fences, cultivated land, roads, cow paths, lanes, and every sign of occupation and civilization extend in many places to the cut bank. When we add to this the fact that Texas exercised jurisdiction and issued patents to lands up to the cut bank, and that without interference from Oklahoma or the United States, the decision of the Court seems to be by far the more natural one to the actual resident if we disregard the future difficulties that river changes will bring. In the light of actual ownership during the past 50 years the decision will commend itself to the inhabitants of the valley and strengthen their sense of confidence in the soundness of our highest tribunal—in itself a highly desirable result.

Practical Effects of the Decision

The distance from the so-called cut bank to the water is nothing whatever in many places along the lower course in times of normal flow, and there are

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[6] Had the Supreme Court decided upon the bluffs along the southern edge of the valley as the permanent bank and boundary it would have involved defining the bed as the whole valley floor.

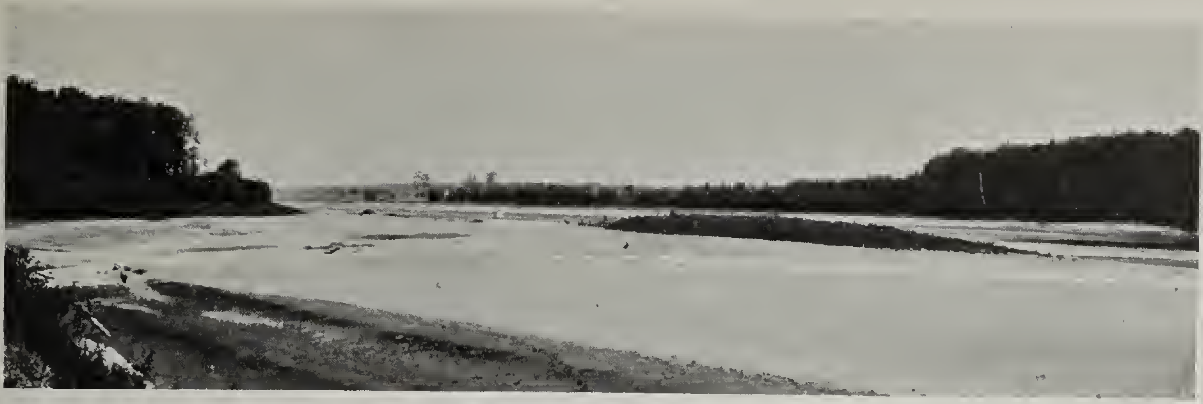


Fig. 16

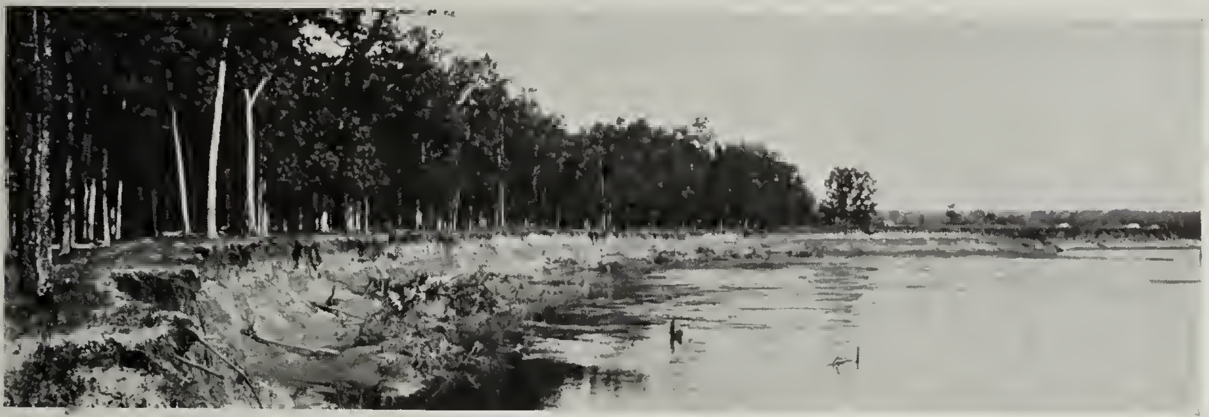


Fig. 17

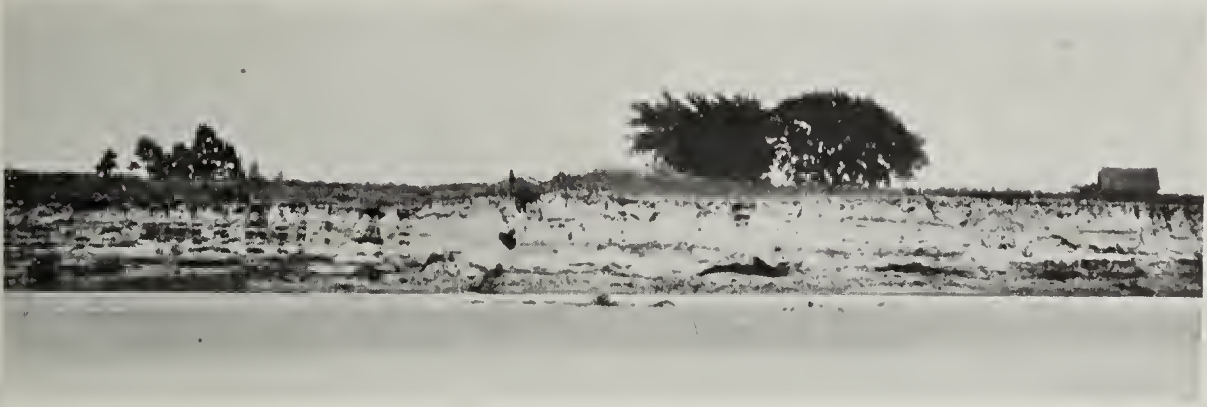


Fig. 18

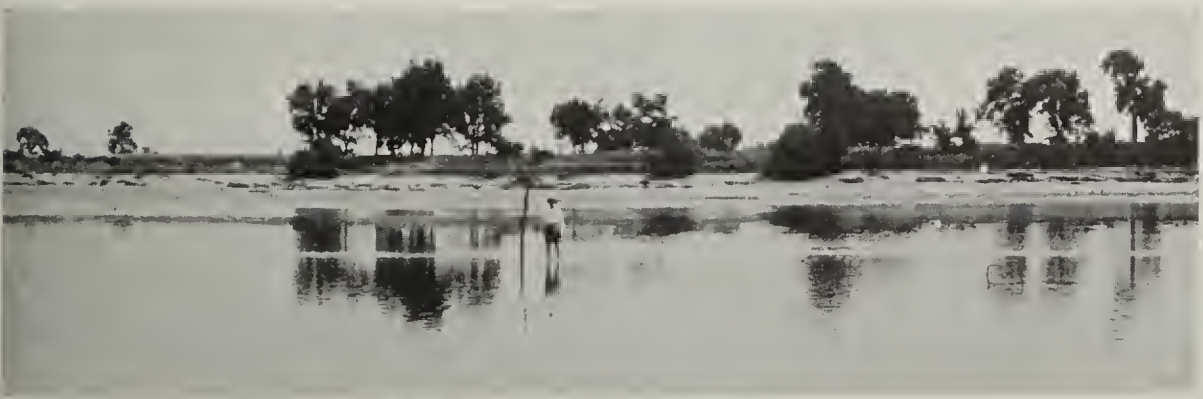


Fig. 19

Figs. 16–19—Illustrations of the cut bank of the river. The problem of the boundary commissioners will be to locate their monuments accurately under these dissimilar circumstances. Figure 16—Valley floor and the definite margin in the lower valley in the timbered belt (Red River County) where the river is measurably restricted. Figure 17—A well-defined bank as developed on the outside margin of the meander curves in the lower river (Red River County). Figure 18—Middle portion of the river (Cooke County) where a cut bank is exceptionally well developed. Figure 19—Shallowness of the river and the low and indefinite banks characteristic of many miles of the river border throughout the boundary zone (Montague County).

many other places where no such thing as a true cut bank exists. To this end the Court has wisely stipulated that when the boundary commissioners locate and mark the boundary upon the ground it shall be in accordance with the principles stated in the decision and also that the action of the commissioners is to be subject to the approval of the Court. The spirit of the decision clearly is that there shall not be strips of land lying between the cut bank and the river, situated on the Texan side of the river yet subject to Oklahoma's jurisdiction. On the contrary, the decision is that the territory of Texas shall extend to the edge of the cut bank; and, if a cut bank does not exist, some correlative natural feature, probably a recognizable line of flow at times of normal high water, will be taken to indicate the position of the boundary.

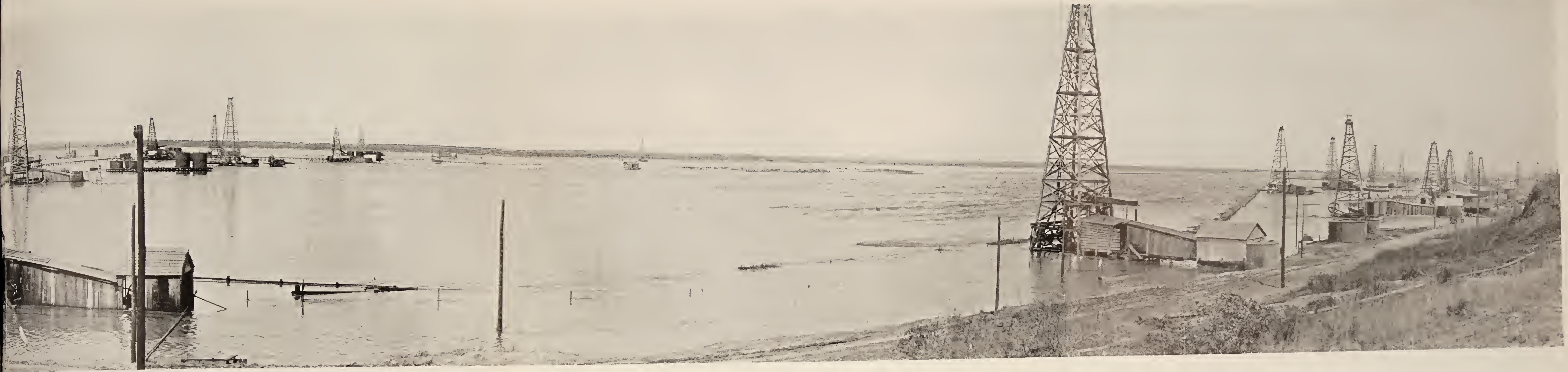
In the upper half of the river at many places the stream at times of low water will be formed of a single thread lying, let us say, upon the Oklahoman side of the bed of the river. The cut bank in the upper part of the river is a far more persistent and easily recognizable feature. Its face is commonly composed of raw earth freshened by the last flood. Its top is crowned with a cover of grass, in places thin, that extends down to the edge of the bluff from the adjacent terraces and uplands. From its foot, out toward the dwindling stream that we have pictured above, there extends a broad waste of bottom sand channeled by the current of the river over most of its extent and bearing a certain amount of wind-drifted and wind-rippled dune material.

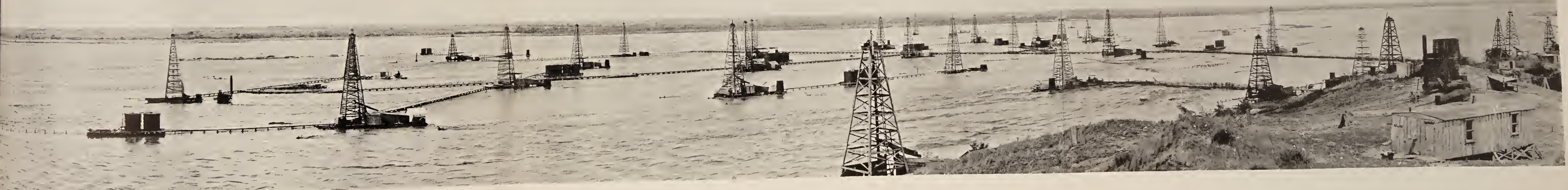
Should a farmer who lives upon the southern side of the valley and owns the land adjacent to the cut bank desire to water his stock he would have to drive them in some instances nearly a mile to water over land belonging to the United States (the southern half of the bed) and into land belonging to an Oklahoman riparian owner (the northern half of the bed) in order to reach the stream. Of course he would be wiser to drill a well, and in fact most farmers have wells equipped with windmills; but in the rare case where a ranchman desired to water his stock from a natural flow such would be his procedure.

It was brought out humorously in the testimony that if such a Texas farmer wished to go down to the bank to fish at times of low water he would in certain places have to have a fish pole a mile long in order to fish in the stream to which the Treaty of 1821 solemnly gave him the right of access in specific terms, and his fish pole would have to extend right across a strip of land owned by the United States and project into the farms of riparian owners in Oklahoma.

THE LINE OF 1821 IS NOT FOLLOWED

The Court recognized and applied the process of accretion and avulsion in the study of the evidence in the Red River case. It admitted operation of the process but confined itself to a few cases only in spite of the declaration that "The boundary as it was in 1821, when the treaty became effec-





See Plate I, opposite p. 166.) The bridge may be identified from three to four inches to the left of the right margin. Other short bridges have been built to the oil wells to avoid flood waters. Since the photo-
the oil territory.

20, and at the western end of the oil territory. The river is in direct contact with the Texas bluff at the extreme left. On the opposite side is a low peninsula that extends northward to the Oklahoma bluffs. In
an island. The new channel now takes the whole flow of the river. The course of the new channel is shown by the figures 1 and 2 on the map, Plate I, opposite page 166.

tive, is the boundary of today, subject to the right application of the doctrines of erosion and accretion and of avulsion to any intervening changes."[7] An island in the upper part of the river at Mile Post 575, near the line between Hardeman and Wilbarger countries in Texas, was claimed by Texas and given to it by the decree of January 15, 1923, on the ground that it had been a part of the fast land on the south side of the valley up to 1902 "and then severed from it by avulsive action in time of flood;" so that the boundary is made to pass on the north side of the island in recognition of the physiographic processes that operated to make it an island. The amount of land involved is very small, however. It is about a mile in length and a half mile in average width and, so far as I know, has no special economic value. It will be noted that avulsion was established as of a late date and could be confirmed by human witnesses. It did not fall into the class of avulsions which were established by physiographic and ecologic evidence.

The manner in which the Court steered its way between the two processes is best illustrated by its decision in the case of Goat Island and Burke Bet Island. These lie, the one immediately below (east of) the Big Bend, the other west of the Texas end of the Grandfield Bridge (Pl. I). And it is in just this section that the oil interests are concentrated. Texas claimed them on the ground that they were once connected with the southern side of the valley and have since been separated by avulsive action. The Court found that neither island was ever part of the permanent fast land on the south side. By this decision and by further deciding to follow the cut bank around the Big Bend the Court rejected the island-building hypothesis of some of the experts appointed by the United States and Oklahoma. The evidence in support of island building clearly showed, not merely from the physiographic detail of the surface but also from the soil sections made with great care, that the river migrated northward across the valley floor at the Big Bend, partly by the process of accretion but chiefly by the process of avulsion in four main stages. By changes in its channel it left islands behind which, through the deposits of flood water and chiefly through wind action, became connected with the fast land on the south. The proof of this process seems conclusive; and it would appear that in the face of such proof the boundary should lie, not on the cut bank, but farther south.

The trouble with the avulsive principle is that it can only be applied in those cases where the change in the course of the river is a matter of historical record or can be proved by the testimony of living witnesses. If we attempt to fix the date on which the river left a given channel and occupied another by the freshness of the topographic forms, the limits of error are exceedingly wide, so wide in fact that the Court felt in this case it could not accept the judgment of the experts even though their conclusions fell well within the limit of one hundred years, the time that has elapsed since the treaty of 1821 with Spain.

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[7] The question of sovereignty is rather complicated for the layman in a case of this kind, where the property of the United States lies within the boundary of a state. It appears that the state has police power over the whole of the land within its boundaries. The rights of the United States pertain only to the proper use of the tract it owns, whether in the development of its mineral resources, its forests, or its scenic features. It may sell or lease its rights and the purchasers are subject to the jurisdiction of the state.

Judicial Determination of River Bed

By reference to Plate I and Figure 14 it will be seen that the greater part of the bed of the river is dry at low-water stages. This dry portion of the bed Texas counsel and experts referred to consistently as a "sand plain." It was the Texas contention that the southern bank of the low-water channel should be the boundary because this was the bank to which a Texan would come when seeking the river during most of the year. Had this contention been sustained Texas would have possession in places of all the islands as these exist at high water. This is made clear by a reference to Plate I, opposite page 166, where the main low-water channel is seen, now on the Oklahoman side, now on the Texan side, of the bed of the river. In the former case all of the islands of high water would be included in the so-called sand plain. Realizing this difficulty every effort was made to apply only the elementary definition of islands as "bodies of land surrounded by water." This would have excluded from the application of the treaty of 1821 between Spain and the United States islands surrounded by water only at times of high water. The importance of the definition lies in the treaty stipulation that all the islands were to belong to the United States. The difficulty with this contention depends on the fact that the so-called sand plain is formed by the river, bears every mark of river action throughout the dry period, is moving downstream at times of flood in contrast to the fixed character of terraces and flood plains, and is without vegetation up to the line of the cut bank on either side (see Fig. 9).

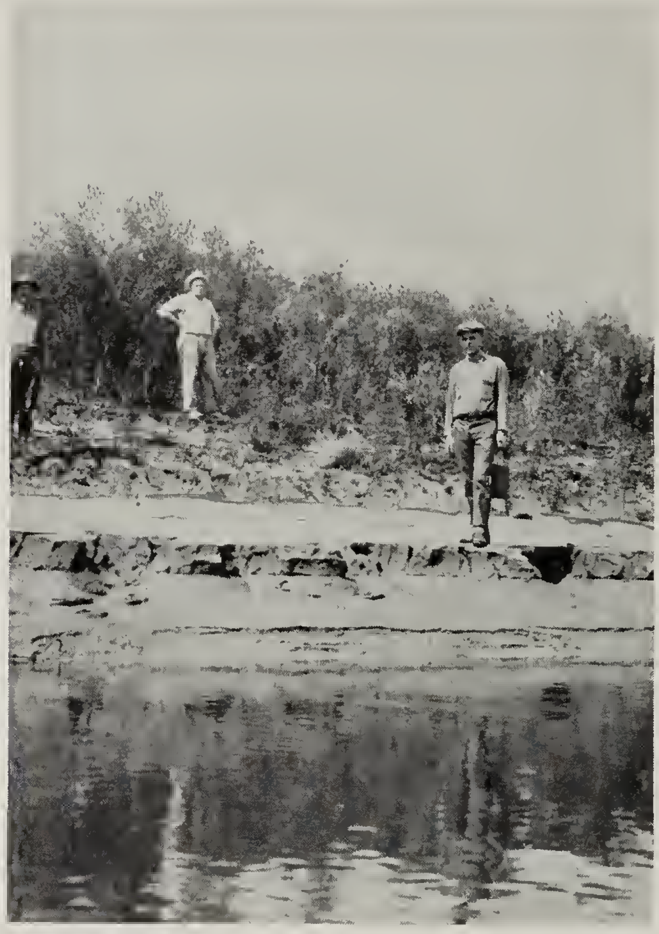

FIG. 22—Nature of the cut bank of the Red River north of Ringgold, on the Texas side. Each stage in the fall of the water is marked by a narrow shelf fronted by a tiny bluff. Somewhere between the uppermost and lowermost of the three figures the boundary will now be located; i. e. (according to the text of the decision) at the "mean level of the water when it washes the bank without overflowing it."

If such a view had been supported by the Supreme Court there would have been loosed an incalculable amount of trouble, for all previous cases of

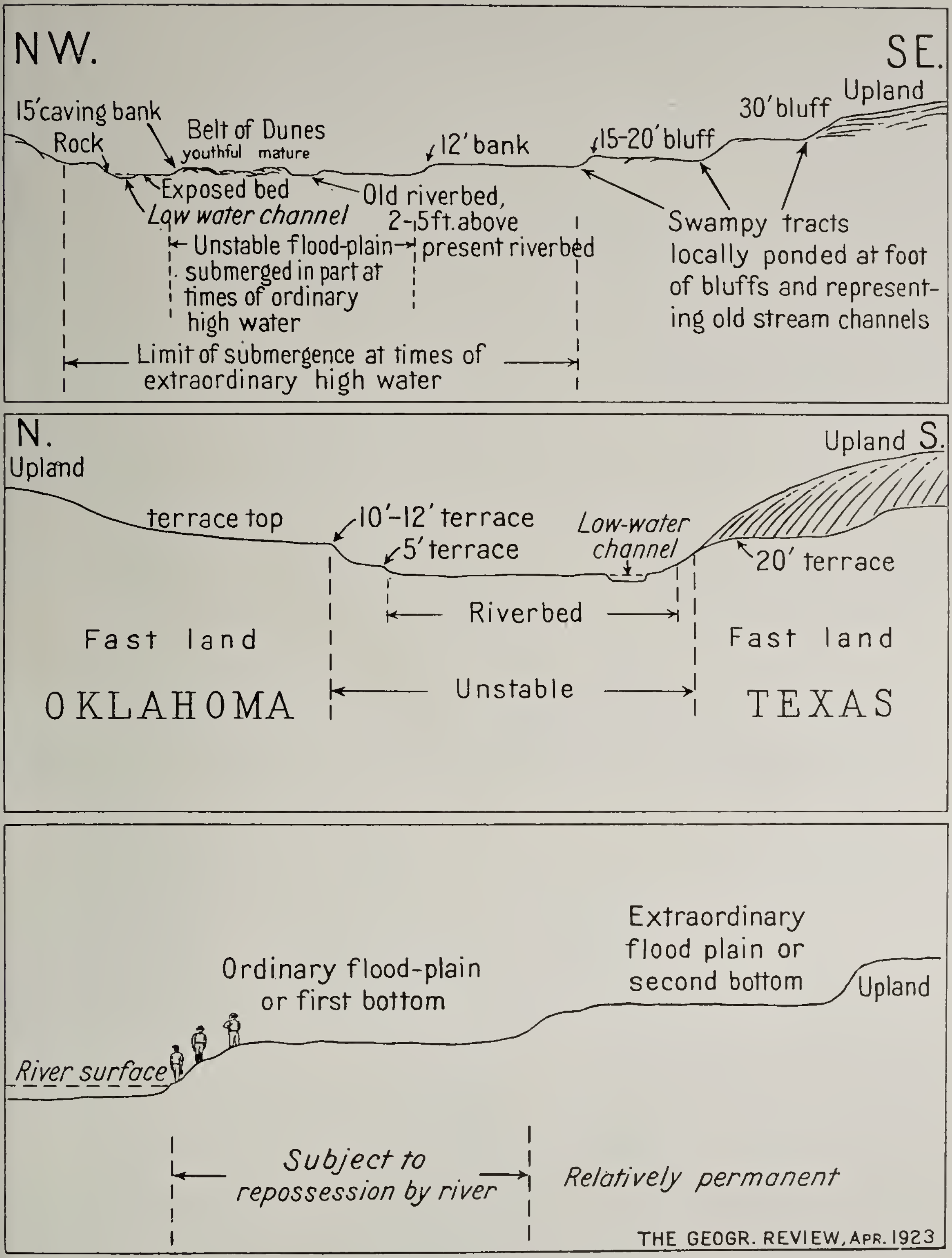
NW.
SE.
15′caving bank
Rock
Belt of Dunes
youthful
mature
12′ bank
15-20′ bluff
30′ bluff
Upland
Exposed bed
Low water channel
Old riverbed, 2-5ft. above present riverbed
Unstable flood-plain submerged in part at times of ordinary high water
Swampy tracts locally ponded at foot of bluffs and representing old stream channels
Limit of submergence at times of extraordinary high water
N.
Upland
terrace top
10′-12′ terrace
5′ terrace
Low-water channel
Upland
S.
20′ terrace
Riverbed
Fast land
Unstable
Fast land
OKLAHOMA
TEXAS
Extraordinary flood plain or second bottom
Ordinary flood-plain or first bottom
Upland
River surface
Subject to repossession by river
Relatively permanent
THE GEOGR. REVIEW, APR. 1923

FIG. 23—The form of the floor of the middle and lower portions of the Red River valley is shown by these three typical sketches. In the upper river no such systematic relations are found; on the contrary flood plains of the normal type are often wanting altogether, and the river frequently swings against the margins of benchlands or the foot of the bluffs at the valley margin (see Figs. 9 and 21). The two upper sections are in Grayson County, the lowermost in Montague County.

river boundaries would now be re-examined by interested parties. The reason for this is of special geographical interest. In previous decisions a river has been defined as water flowing in a channel. It has a bed and two banks, so that "water," "bed," and "banks" are three standard features respecting which a court decision must be specific and conclusive. If we should now place between a main cut bank and the bank of the low-water channel a fourth feature, namely a "sand plain," similar sand plains, however small in extent, would be found on many rivers and inevitably would lead to litigation—inevitably, because there is not elsewhere, as in the case of the Red, the question of ownership merely or chiefly. There are in other rivers questions of navigability and of surface jurisdiction and of the use of the immediate banks in the construction of retaining walls for dams that form parts of irrigation schemes, etc., etc.

This does not prevent us from recognizing the dry river bed as a feature more highly developed in the region of western Texas, and other similar climatic and physiographic regions of the world, than elsewhere. But we should not stop here. The feature is a climatic result chiefly and in the driest deserts of the world it has led to a type of stream still more flashy than the Red and still more abnormal when compared with the streams of the customary type in regions of normal rainfall. Indeed, in the driest deserts, stream channels with bed and cut banks may lie exposed to the air for all but a short season of the year, or, in extreme cases, for years at a time, without a drop of water flowing through them. The return of the water may be so long delayed that sand dunes and irregular drifts may be formed upon the banks and bed. Nevertheless, when the stream comes down again in flood in response to the long-delayed rains these obstructions are modified or cleared away, the bed is remodeled, and the banks are in places scoured afresh.

Future Litigation Inevitable

It is the purpose of a judicial decision to settle litigation in a broad way and not merely to settle a part of the difficulty and leave the field open for fresh litigation in a new form. In the present case it is certain that a great amount of litigation will ensue, with two property boundaries involved, not merely one. We must recall that the lands of riparian owners in Oklahoma end at the medial line of the river bed and that this boundary may be of equal importance with the cut bank on the south side that forms the common boundary of Texas and Oklahoma. Referring to Plate II, opposite page 168, it will be seen that in a single year the cut bank at the western border of the Big Bend was moved southeastward a distance of 500 feet. Had a well been located upon the cut bank in its earlier position it would then have been in the territory of Texas, but the changes brought about by a single flood would have transferred this well to the territory of the United States; for the river bank gained its new position not by avulsion but by the slow process of erosion recognized in law as a process that carries the boundary into a new position.

Legally Shifting Boundaries

This is not all. If the cut bank changes at a given point, then the medial line of the bed has also shifted by half this amount provided the opposite cut bank remains stationary. *The effect of the decision is that both the cut banks and the medial line are constantly on the move legally as well as in fact and hereafter as well as heretofore.* It will result that a well located immediately south of the medial line of the river bed, the property of the United States before a flood, will become the property of a riparian owner in Oklahoma after the flood. This will have its inconveniences, but the Court must have thought it to be the lesser of two evils.[8] In any case, as a practical matter, *it gives to the United States a maximum of the proceeds of the oil actually taken out of the river bed*, on account of the apparent tendency on the part of the river to increase the width of its bed. It seems to be crowding out progressively toward the valley walls on both sides so that the total amount of land eroded on the two sides exceeds the total amount of land elsewhere built up on both sides. The discrepancy is marked, and it may be significant of a continuing process that will greatly advantage the United States in the future extraction of oil from the river bed.

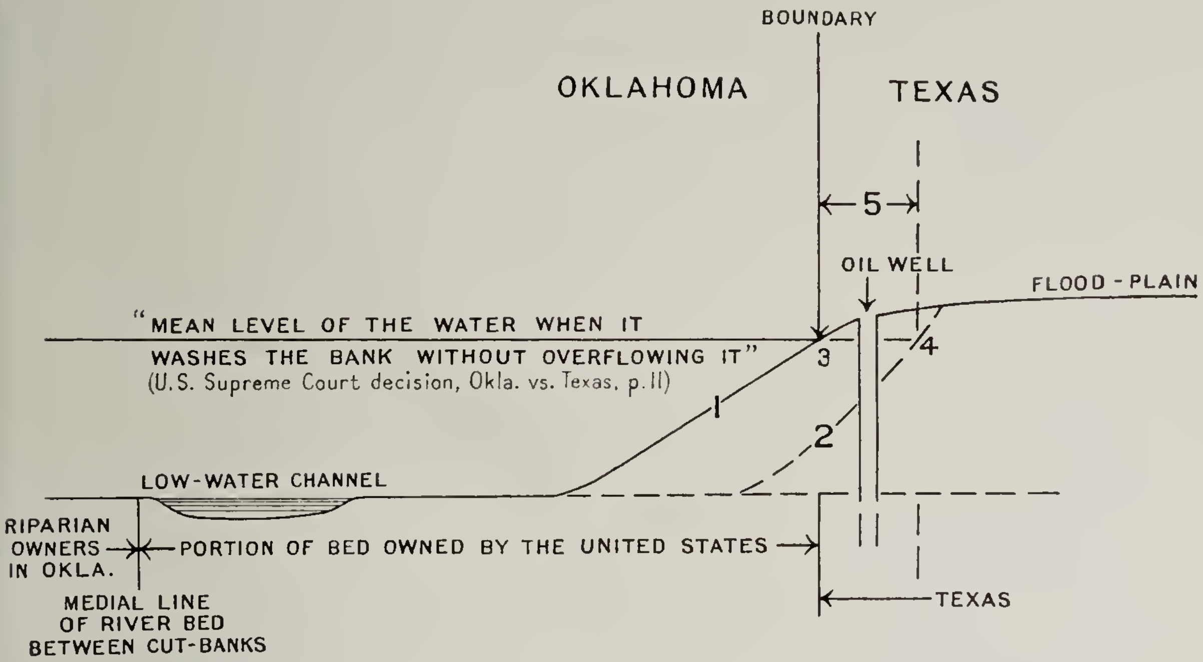
BOUNDARY
OKLAHOMA
TEXAS
5
OIL WELL
FLOOD - PLAIN
"MEAN LEVEL OF THE WATER WHEN IT WASHES THE BANK WITHOUT OVERFLOWING IT"
(U.S. Supreme Court decision, Okla. vs. Texas, p. II)
1
2
3
4
LOW-WATER CHANNEL
RIPARIAN OWNERS IN OKLA.
PORTION OF BED OWNED BY THE UNITED STATES
MEDIAL LINE OF RIVER BED BETWEEN CUT-BANKS
TEXAS

FIG. 24—The figure illustrates one type of difficulty that appears to arise as a result of locating the boundary on the cut bank. If 1 represents the cut bank at noon of a given day when the river is in flood, 2 may represent its position at 4 P.M. In that time the oil well was transferred from Texas to Oklahoma, but, the river being unnavigable, the oil well belongs to the United States though lying in the territory of Oklahoma. If the cut bank shifts to 2, the medial line has shifted to the right also by half the amount of 5, provided the northern or left-hand cut bank has remained stationary. Decrees of the Court or Acts of Congress may affect the oil wells gained by the United States, but those lost by it owing to the shifting of the medial line are permanently lost unless the river should shift at a later time by the same process in the opposite direction.

EXPERT TESTIMONY AND THE COURT

If there is any moral in the experience of the scientists employed in the case it is that the present situation whereby experts are employed by the litigants instead of by the Court should be ended at the earliest opportunity. On the face of it it is absurd for a scientific man to be called into a case to give testimony regarding facts under conditions which require him to be intimately associated with counsel and to participate in discussions designed to foil the argument of the opposing side. This is not the spirit of scientific research. Under these circumstances it is only by constant watchfulness that one can avoid importing into the testimony, if not in fact then in spirit, a bias in favor of one side as opposed to the other. This matter has been ably argued by Dr. Ransome[9] and cannot be too strongly emphasized when, as in this case, the interests involved are powerful, the State governments determined, and the scientific questions complicated in almost every conceivable way. Then, if ever, it becomes necessary for the expert to take a judicial view, and this he can do to best advantage only if appointed by the Court itself.

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[8] It should be understood that these and many similar difficulties that arise in the application of a decision by the Supreme Court may be overcome at least in large part by subsequent decrees of the Court. A *decision* is for the purpose of establishing the principle or principles that are to apply in a given case; a subsequent *decree* is necessary to make the decision effective. The parties in interest confer upon the subject and submit a form of decree for the Court's acceptance or modification; or the Court may frame its own decree. This is to avoid so far as possible the beginning of a new dispute over the meaning of a decision just rendered.

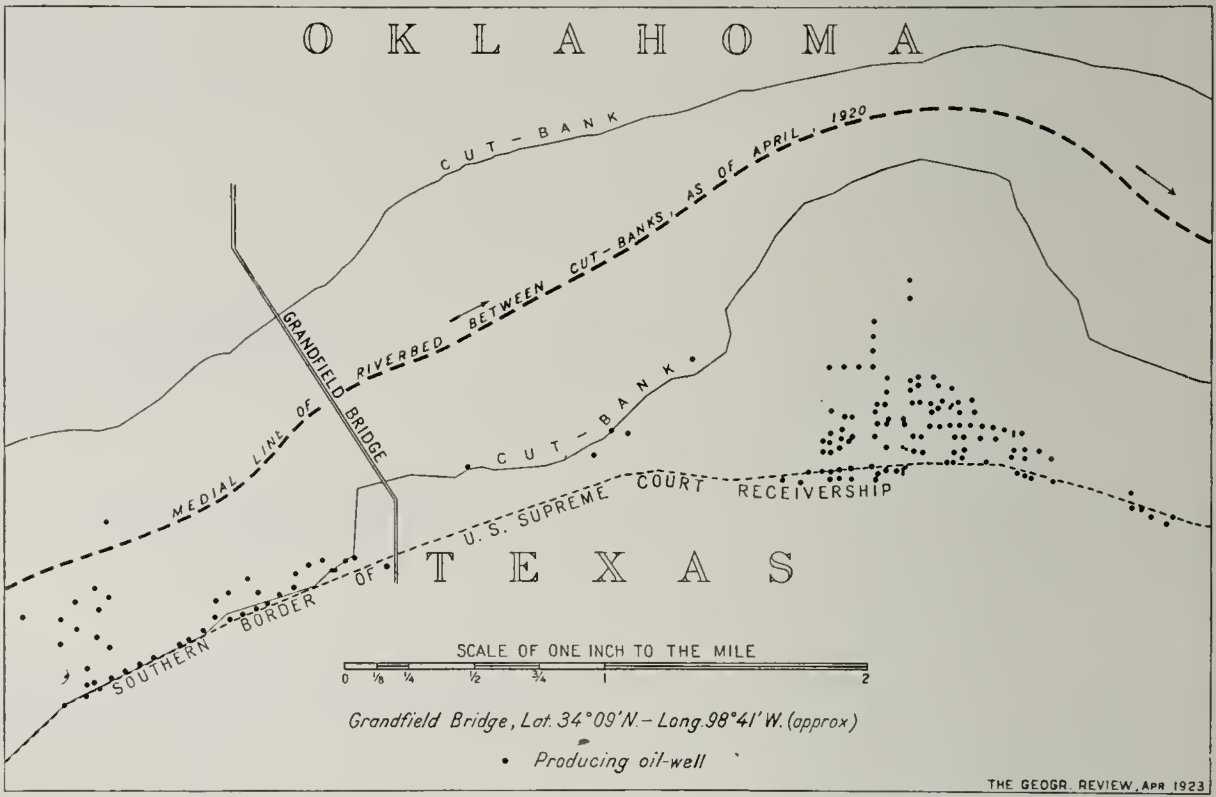
OKLAHOMA
CUT-BANK
RIVERBED BETWEEN CUT-BANKS AS OF APRIL 1920
GRANDFIELD BRIDGE
MEDIAL LINE OF
CUT-BANK
U.S. SUPREME COURT RECEIVERSHIP
SOUTHERN BORDER OF
TEXAS
SCALE OF ONE INCH TO THE MILE
0 1/8 1/4 1/2 3/4 1 2
Grandfield Bridge, Lat. 34°09'N.–Long. 98°41'W. (approx)
• Producing oil-well
THE GEOGR. REVIEW, APR 1923

FIG. 25—The position of the producing oil wells in relation to (1) the medial line of the bed of the Red River, (2) the Texas cut bank in the receivership area in the Big Bend district (see Pl. I). This district was the focus of the boundary dispute.

To attempt to understand *refinements of scientific testimony as developed by opposing counsel* is to set an impossible task. "The testimony particularly of the experts is conflicting," "We think this testimony is essentially speculative and not a proper basis for judgment." These two sentences from pages 12 and 13, respectively, of the opinion of the Court as handed down by Mr. Justice Van Devanter on January 15, 1923, are suggestive in this connection. On account of the bulk of that testimony (9 volumes of 5513 printed pages, much unprinted testimony introduced by stipulation, two large atlases, in addition to 158 exhibits of photographs, samples of tree rings, soils, etc.) any reader must find his mental apparatus thrown into a state of confusion. Both parties to the controversy were mistaken in their assumption that the subtleties of the testimony would be reflected in the decision, even if the Court could have understood it in all its nuances. Both sides would agree that speculation and theory played a large part in the testimony of the experts, but they would also agree that certain things were definitely established. It would have been interesting, for example, to have had the Court recognize the essential and profound difference between the upper and lower sections of the river and to have adapted its decision to this difference. Instead the Court has treated the river as a unit, and to this extent at least the decision appears to look back to rules of law which hardly seem applicable to so specialized a case rather than forward in the direction of scientific research.

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[9] F. L. Ransome: Geologists as Expert Witnesses, *Economic Geol.*, Vol. 15, 1920, pp. 339–349.

Detailed Records from Now On

The truth of this last statement is realized if one clearly envisages the future of the river. Upon the ordinary or lower (as distinct from the extraordinary or higher) flood plain, avulsion takes place occasionally in the upper (western) section of the river. One striking case occurred during the progress of the suit, three miles west of the Grandfield Bridge (the change has been from the blue channels of Plate I to the line of depressions marked by 1 and 2). It will be a nice question for a future court to determine the exact character and time of occurrence of stream changes in instances *where avulsion and erosion are inextricably mixed in their action during different stages of the same flood.* The river now needs a diarist to record its capricious behavior in all moods. The airplane camera can secure a part of the record. Trained and continuous observation at critical places seems indispensable. Possibly the oil pools will be exhausted in a few years and before many changes have taken place. When ordinary land values obtain there will be less interest in an exact location of the boundary. The decision says in effect, "We will take the river as it is, and when the inevitable changes come the boundaries will change with them."

EXPLORATIONS IN EASTERN ECUADOR

By Joseph H. Sinclair and Theron Wasson

[With separate map, Pl. IV, facing p. 210]

In the latter half of 1921 the writers were engaged in exploring a tract of 9600 square miles in that part of Ecuador lying east of the Andes to determine the possibilities for the eventual production of petroleum. The area was under concession by the Leonard Exploration Company of New York, through whose courtesy the publication of this paper is made possible.

This area is about one-fifth that of the state of Pennsylvania. Nothing was known of its geology, no mapping had ever been done, there were but a few muddy trails, and little knowledge was at hand regarding the climatic conditions. Four months were spent by us in traverses through the jungles on foot and in canoe. Our route, including some back-tracking, amounted to about 625 miles from the point of our departure at the end of the railroad, Pelileo, to our return at Riobamba.

The Journey into the Oriente

From the Andean highlands the most convenient route into the eastern region of Ecuador, called the Oriente, is to leave the Guayaquil and Quito Railway at Ambato and descend the Rio Pastaza. We first took the railway, known as the Ferrocarril al Curaray, from Ambato to Pelileo. Some 70 miles, of the proposed 180 miles, have been surveyed; but rails have been laid only as far as Pelileo, 21 miles east of Ambato. From this point we set out on horseback on August 11 and proceeded to Baños, situated two miles below the point where the Chambo and Patate Rivers unite to form the Pastaza at the base of the great volcano, Tunguragua. Baños is exactly 30 miles east of Ambato. We found it to be a town of about fifty houses with several hundred inhabitants. It is at an elevation of 6014 feet above sea level and just above the limits of the Amazon jungle. Baños owes its name to hot springs half a mile east of the village. About five miles below here the Pastaza passes over the famous Agoyan Falls, 198 feet high. The snow-capped peaks and glaciers of the watershed above this point furnish a constant supply of water, and it has been estimated[1] that 200,000 horse power could be developed here. Continuing on horseback below the falls, we traveled on a trail notched into cliffs of schist and gneiss 1000 feet above the river, from which height it appears to be a roaring torrent 200 feet wide. Here and there high up the sides of the valley are hanging lateral valleys through which streams enter the Pastaza over falls. Altogether this is one of the wildest valleys imaginable.

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[1] C. H. Moore: Railway Construction in Ecuador Just South of the Equator, *Engineering News*, May 14, 1914, New York, pp. 1053–1057.

Several miles below Baños we entered the Amazon jungle. We crossed the Rio Verde by bridge, the Machay by a dangerous ford. At Quebrada San Francisco, 42 miles east of Ambato, we noticed sedimentary rocks for the first time. Similar rocks were seen at the Rio Topo, 50 miles east of Ambato, where a bridge has been built. Shortly beyond the Topo we had to leave our horses, and our journey from there on was on foot. At Mera, 55 miles east of Ambato, at an elevation of 3800 feet, the Pastaza emerges from its great canyon. We found the village to consist of a string of about ten houses. It is in the belt of maximum rainfall.

TRAVERSE TO THE RIO ANZU

At Mera our survey started because we could tie our traverse to the survey of the Ferrocarril al Curaray which was run from the Guayaquil and Quito Railway at Ambato. Our method of surveying was as follows. We used a 300-foot length of linen tape treated with paraffin and employed a method used by us on the United States Geological Survey, orienting the traverse board by magnetic needle and then sighting to the voice of whoever was at the head or rear of the tape, taking elevations at each tape length with the aneroid barometer. This traverse was checked at controlling points by latitude observations made on stars with a precise transit. In connection with observations for latitude the true meridian was established at several points by transit observations on circumpolar stars or calculated from solar observations. The compass needle was then read on the established meridian. A Buff precise transit with a five-inch needle was used for this work.

From Mera we followed the Puyo trail across the Rio Pindo Chico and, leaving this near Puyo, turned northeastward through the jungle to the Rio Anzu. At the point where we first reached the Rio Anzu it is about 160 feet wide, flowing in a bed of huge granite boulders. It is very swift and almost waist-deep with the characteristically crystal-clear water of the mountain streams to which Spruce[2] has made reference. We followed the bed for some distance to Embarcadero, 1780 feet in elevation, the head of canoe navigation, having traversed 36 miles through the jungle from Mera without seeing even an Indian hut. We arrived at Embarcadero on August 29 and descended by canoe 12 miles to the village of Napo on the Napo River. On all previous maps the Rio Anzu has been shown as a small tributary of the Napo flowing into it from the west. Our survey showed it to be a much larger and longer river flowing parallel to the Andean chain from the south into the Napo.

The width of the valley of the Rio Napo at Napo nearly coincides with the width of the stream, there being a steep hill on the south bank and only a narrow flood plain on the north bank from which the ascent is rather pronounced to the upland. It is on this narrow flat on the north bank of the river that the settlement of Napo is located at an elevation of 1680 feet above the sea.

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[2] Richard Spruce: Notes of a Botanist on the Amazon and Andes, London, 1908; reference in Vol. 2, p. 145.

The Settlement of Napo

From the top of the cleared hill on the south bank of the river we looked west over an expanse of forested hills having an average elevation of 2000 feet above the sea. These rise gradually westward to about 4000 feet, where the wall of the Andes cuts them off. On a clear day a fine view is afforded of the snow-capped Andean Range from Antisana on the north to the great volcanic cone of Sangay on the south, a sweep of 120 miles.

The settlement of Napo at the time of our visit was composed of three or four white Spanish-speaking families who have farms of a few acres each on the north bank of the river on which they raise cattle and horses and a few farm products, such as yuca, plaintain, corn, and sugar cane, sufficient only for their own needs. Among these families is that of Sr. Manuel Rivadeneyra, who acted as our guide. Much of the success of the expedition was due to his knowledge of the country and his ability to hire Indian carriers. In Napo, as in the other settlements of eastern Ecuador, no Indians are resident except as servants and laborers for the white families. They are to be found living on small clearings, hidden in the jungles along the streams where they raise yuca and plaintain, fish a little, and also pan gold from the gravels along the bed of the river. Each white family has under its patronage a number of Indians whose gold is taken in exchange for cloth and other commodities obtained from Quito, an eight days' journey northward over a rough trail. We found the families at Napo to be remarkably intelligent, strong and healthy; but, as in the case of all pioneers, forced to depend on themselves in all emergencies. The children are educated at home, and there are no doctors or priests in the region.

The climatic conditions of Napo are very healthful. Temperature readings, taken during our stay from August 29 to September 23, 1921, show an average shade temperature of 77° F. The maximum recorded was 82°, and the minimum in the daytime, 66°. At night, however, especially when it rains, it is much cooler, and covers are always needed in sleeping. We saw no mosquitoes and few other insects. The residents say that there is no malaria at all. Napo is not subjected to excessive rains as are such towns as Mera at the base of the Andes. The residents also informed us that the rains were somewhat greater in the other months of the year, which would indicate a cooler temperature in those months.

We spent twelve days in Napo making preparations for our trip down the river, taking latitude, longitude, and azimuth observations, and collecting fossils.

Survey of the Rio Napo from Napo to the Rio Coca

On September 5, with two canoes, we started a stadia traverse down the Napo. We used a rod 16 feet long, its feet divisions painted alternately black and white, and a 15-inch Gurley traverse table with a telescopic alidade, with which we were able to obtain sights 3200 feet long by using one half the stadia interval. The river for 90 miles below Napo is characterized by numerous gravel bars so that we had no difficulty in finding rod and instrument stations.

Table I—Temperature Readings at Napo (1850 Feet), 1921

Aug. 29	6.00 P. M.	78.2° F.	showers	
Aug. 30	9.30 A. M.	77.7	fair	
	noon	78.6	fair	
Aug. 31	8.00 A. M.	79.7	rain	
	noon	79.7	rain	
	8.30 P. M.	79.3	rain	
Sept. 1	8.00 A. M.	73.4	rain	
	7.30 P. M.	66.2	rain	
Sept. 2	11.00 A. M.	78.5	fair	
	6.00 P. M.	77.8	fair	
Sept. 3	8.00 P. M.	75.5	fair	
Sept. 4	6.00 A. M.	78.0	fair	
Sept. 21	8.00 P. M.	78.0	fair	
Sept. 22	6.30 A. M.	73.0	fair	
Sept. 23	9.00 A. M.	73.9	fair	
?	7.00 A. M.	72.0	cloudy	?
	6.30 A. M.	68.0	cloudy	
	7.20 A. M.	72.0	cloudy	
	6.30 P. M.	77.0	cloudy	
	9.00 A. M.	75.0	fair	
	11.00 A. M.	78.0	fair	
	11.30 A. M.	80.0	fair	
	2.30 P. M.	82.0	fair	
	3.30 P. M.	80.0	fair	
	7.30 P. M.	78.0	fair	
	8.30 P. M.	76.0	fair	

The first settlement of white people below Napo is at Remolino de Latas, about five miles down the river, where one or two families live. Shortly below this point the river cuts through the contact of the limestones and shales with the overlying red clays and flows, for the rest of its course to the mouth of the Coca, through red beds and alluvium. The flats along the river here and in many other places consist of gravels 9 to 15 feet thick overlying the clays of the red beds. In places claims have been taken up by an Italian syndicate for gold dredging, but no machinery had arrived at the time of our visit. The next three settlements below Remolino de Latas are: Venecia, 7 miles below Napo on the left bank; a ranch on the left bank of the river 11 miles below Napo; and the cattle ranch of Umberto Garcias 17 miles below Napo. The last-mentioned consists of 290 acres of pasture land on the left bank and 125 acres on the right bank, the large ranch house having a beautiful location on the left bank. We were told the owner had 500 head of cattle, the market for which is far east on the Rio Aguarico, a tributary of the lower Napo.

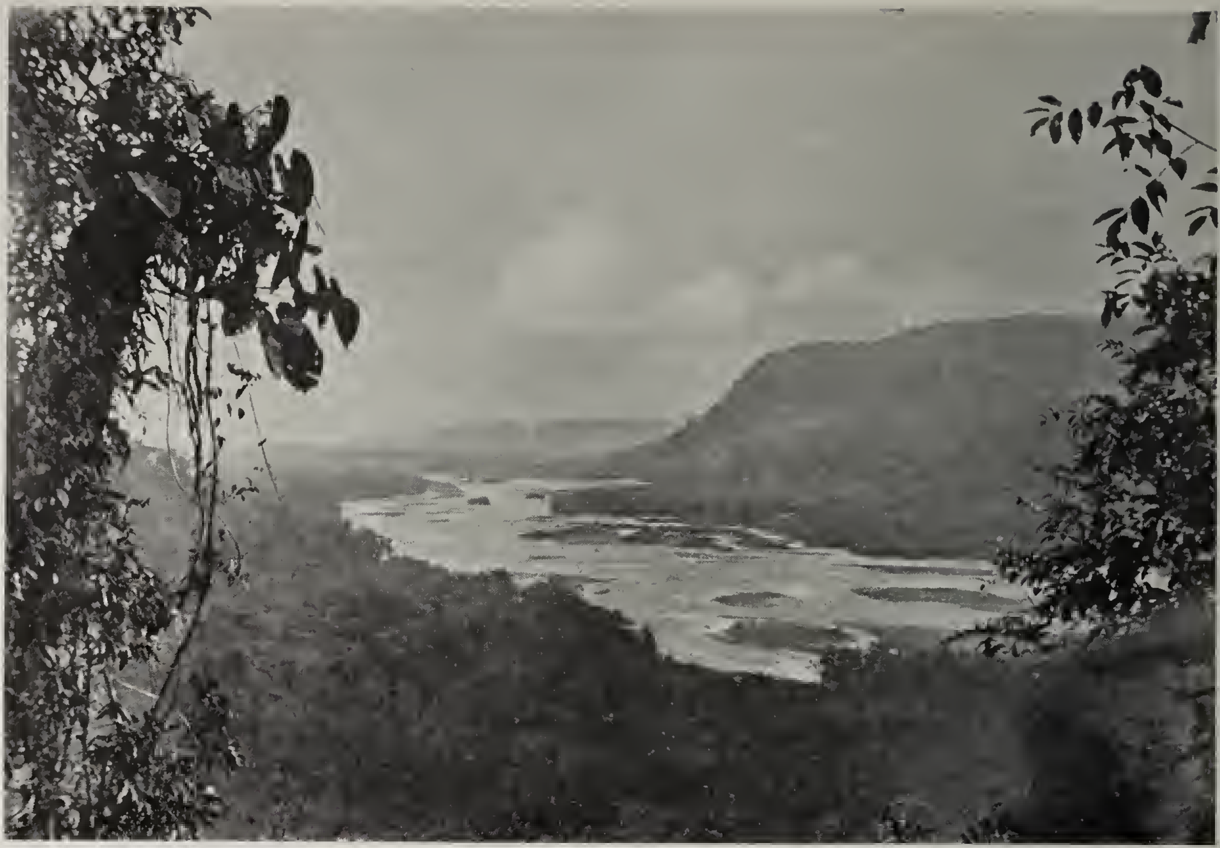

FIG. 1

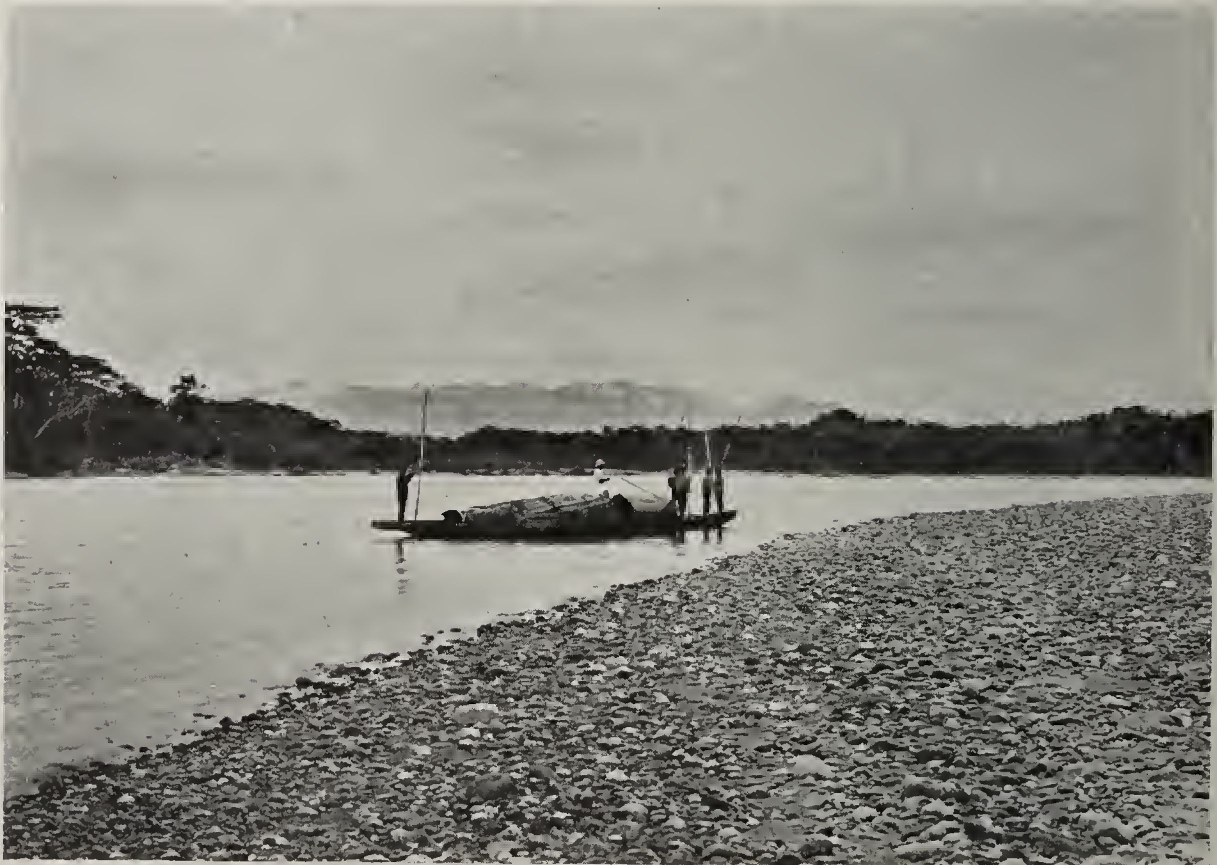

FIG. 2

FIG. 1—The Pastaza River at Mera, 3800 feet above sea level where it emerges from its Andean canyon.

FIG. 2—The Napo River 44 miles below Napo. In the background is the Cordillera Galeras with summits about 6000 feet above sea level.

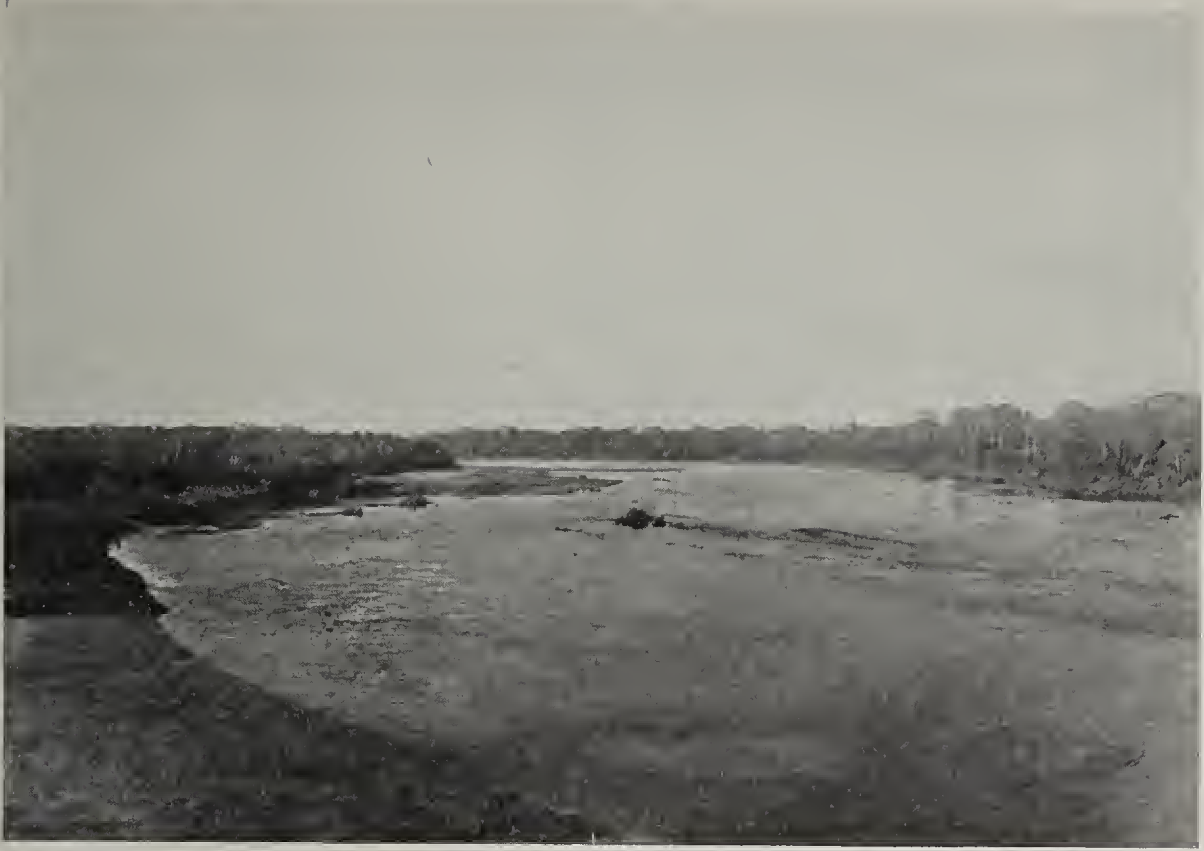

Fig. 3

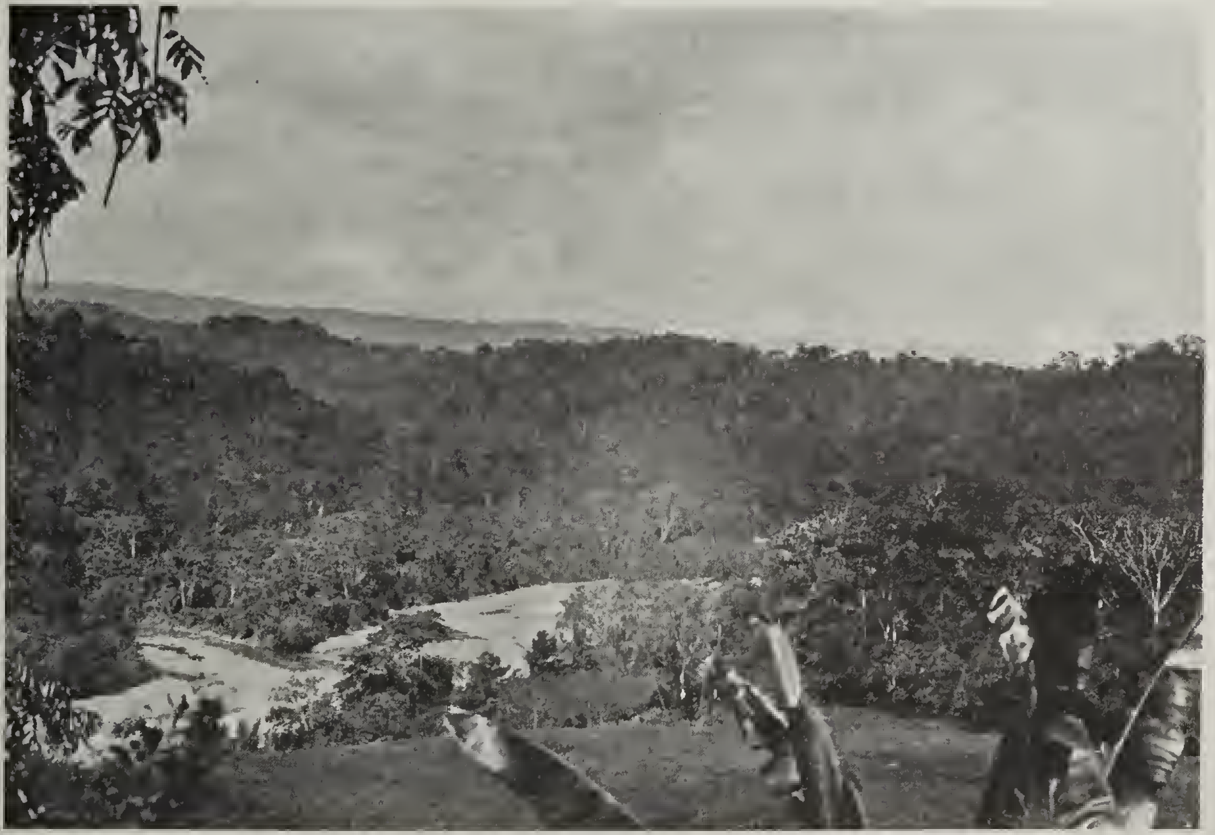

Fig. 4

Fig. 3—The Napo River 80 miles below Napo.

Fig. 4—View from the station of the Dominican mission at Canelos across the Bobonaza River to the upland, over 3,000 feet above sea level, between the Bobonaza and Pindo Rivers.

On September 8, from our camp below the mouth of the Rio Arajuno, we observed to the north a prominent mountain range which our guide informed us was the Cordillera Galeras. Thirty-one miles below Napo we passed the next settlement, Santa Rosa. Forty-four miles below Napo we observed a lofty, cone-shaped peak, about 30 miles to the northwest, which we were told was named Sumaco. Vertical angles and intersections to this from several places on our traverse determined the exact location and gave its elevation as 12,700 feet above the sea. Sumaco is beyond all question the most remarkable physiographic feature we saw on the Amazon plain. We believe our expedition is the first accurately to locate it and obtain its elevation. Wolf says of this peak:

> Outside of the Andean region of Ecuador there appears to exist a small volcanic area or perhaps an isolated volcano in the Oriente, in the upper part of the Napo basin; but no geologist has as yet studied it, and I can only describe rumors of its existence. Even the location of this volcano is not very sure.[3]

Humboldt does not show this volcanic peak, for such it probably is, on any of his maps; and Villavicencio, according to Wolf, shows such a mountain at a very great distance to the northeast of the Cordillera Guacamayo. Hamilton Rice,[4] describing his journey down the Napo River, refers to a cone-shaped peak called "Sumaco."

Two more ranches were passed, making seven in all on the banks of the Napo between Napo and the mouth of the Coca. Near the mouth of the Coca there is a settlement called Armenia, consisting of one or two houses. All the settlements along the Napo are occupied by pioneers of a high type. In addition, there are a few Indian families here and there along the river and doubtless others up the tributary streams.

From Napo to the mouth of the Rio Coca is 97 miles by the river traverse. This stadia traverse of the Napo was later increased to a total of 120 miles by the stretch of 23 miles above Napo to the confluence of the Rio Anzu, up this to the Rio Ila, and up the Rio Ila to the base of the Andes. It is the first accurate mapping ever made of the upper portion of the Napo. The nearest to this is a traverse of the lower Napo from Fortaleza, perhaps 60 miles below the mouth of the Coca, to the mouth of the Napo. This was probably a time survey by boat and thus very rough. The map[5] shows no latitudes or longitudes. The stretch of river between Fortaleza and the mouth of the Rio Coca leaves this traverse entirely separated from our work.

The Rio Napo from Napo to the Rio Coca is an excessively braided stream with numerous side channels of shallow depth. Orton[6] in November,

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[3] Teodoro Wolf: Geografía y Geología del Ecuador, Leipzig, 1892, p. 331.

[4] Hamilton Rice: From Quito to the Amazon via the River Napo, *Geogr. Journ.*, Vol. 21, pp. 401–418; Reference on p. 414.

[5] Richard Payer: Der Rio Napo, *Petermanns Mitt.*, Vol. 40, 1894, pp. 169–171, with map "Originalkarte des Rio Napo und Rio Curaray," scale 1:800,000.

[6] James Orton: The Andes and the Amazon, New York, 1870.

1867, found the current of the Napo at Napo to be 6 miles an hour. Measurements by us on September 21, 1921, 60 miles below Napo, gave 5.5 miles an hour. At Napo the river is 300 feet wide and is deep with a swift current. It is subjected to sudden rises from rains in the mountains. At such times boulders can be heard grinding along the bottom. From Napo to Armenia, a distance of 86 miles, the river is characterized by a succession of rapids. The whites and Indians are experts in navigating these in dugout canoes. By poling upstream in the backwash close to the bank and by following side channels they are able to travel without difficulty. The river cannot be forded at Napo nor at any point in the hundred miles to the Rio Coca. The bottom is rocky and the water clear to about 11 miles above the mouth of the Coca, where a striking change takes place. Islands disappear, mud banks appear; the river has but one channel one-quarter mile wide with sluggish current, muddy water after rains, and a depth sufficient for small steamers. This change may be considered as marking the "fall line," a characteristic of all rivers of eastern Ecuador. The mouth of the Coca is 850 feet above sea level, and the Napo at this point is 2000 feet across. The Coca is distant 400 miles from the mouth of the Napo, which enters the Amazon below Iquitos, a port for ocean steamers with a draft of 20 feet. The maximum cargo we know to have been poled up as far as Napo was a grand piano, moved by a former governor from Iquitos to Tena, where it is now in use. The return from the mouth of the Rio Coca to Napo took us seven days, an average of 14 miles a day of poling. We had six Indians at work nine hours a day.

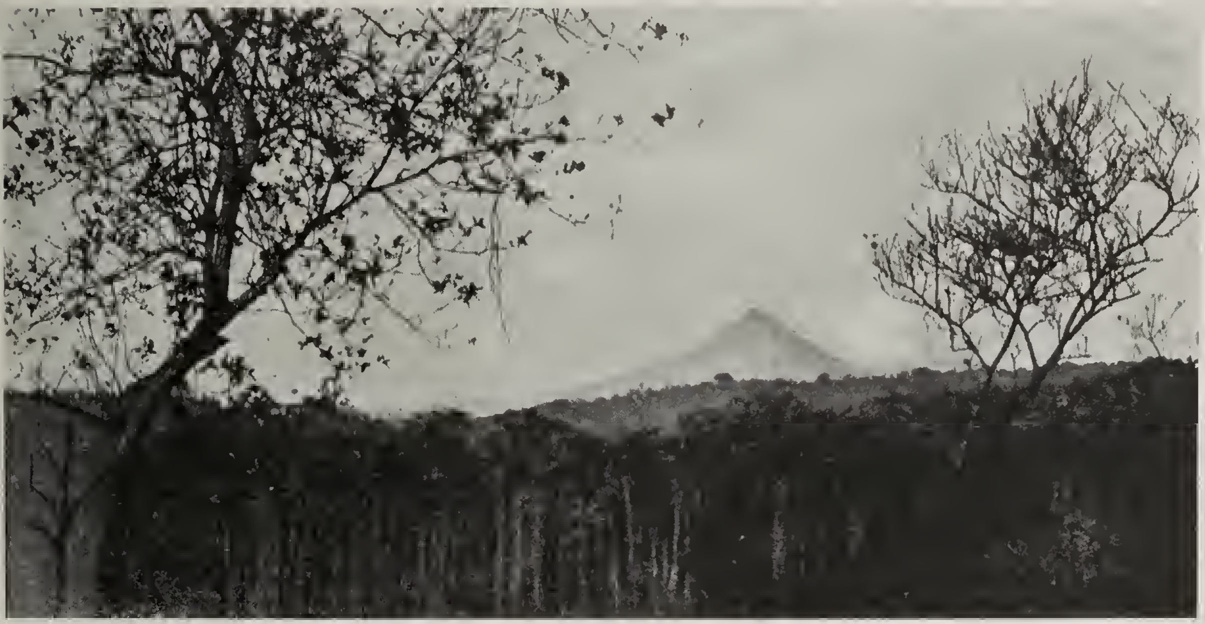

FIG. 5—Mt. Sumaco (12,700 feet) seen from Archidona, from which point it lies 28 miles to the north-northeast. The exact position of this isolated peak, probably a volcano, was determined for the first time by the writers' expedition.

From Napo to Archidona on the Papallacta Trail

The Papallacta Trail is one of the old routes from Quito to the Amazon plain.[7] We mapped 25 miles of it between Napo and the base of the Cordillera Guacamayo.

From Napo to Tena the trail can be negotiated by horses, which by painful experiences have learned to jump across mud holes or plow through them. The trail ascends gradually from Napo, 1680 feet above the sea, to an upland of fairly smooth surface which, between Napo and Tena, is at a maximum of 1950 feet above the sea, 300 feet above the valley bottoms. This is underlain by nearly horizontal limestones. In places on this upland remnants of the red beds are seen overlying the limestones. Both the limestones and red beds are in places covered by thin deposits of volcanic débris. One white family is found on the trail from Napo to Tena, the house occupying the only clearing in the five miles between these two points. Tena is the capital of the Oriente and the residence of the present governor, whose courtesy toward us helped make our expedition a success. Tena, 1700 feet in elevation, lies on the left bank of the Rio Tena, an easily fordable stream, a mile above its entry into the Rio Misahualli. The settlement is surrounded by clearings where cattle graze and crops are raised, and about half a dozen white families reside here. The Indians live, as usual, scattered in the neighboring jungle along the stream banks. Dr. Jameson, who visited Tena in 1857, described it as having been recently built.[8]

Table II—Temperature Readings at Archidona (2000 Feet), 1921

Sept. 26	3.15 P. M.	82.0° F.	fair
	4.00 P. M.	76.8	showers
Sept. 27	7.00 A. M.	72.3	fair
Oct. 1	7.00 A. M.	68.7	fair
Oct. 7	noon	78.0	showers
	7.00 P. M.	77.0	fair
Oct. 8	6.30 A. M.	67.4	fair

The Rio Misahualli, below the mouth of the Tena and below its tributary, the Rio Hollin, flows in a narrow canyon with precipitous walls. We descended the Rio Misahualli by canoe to a mile below the entry of the Hollin about six miles below Tena. Below this point it has never been descended, as the canyon narrows and the river is full of impassable rapids.

On the Papallacta Trail six and a half miles north of Tena and on the left bank of the Rio Misahualli is Archidona, at an elevation of 2000 feet. This is one of the several "towns" founded in the Ecuadorian montaña in the mid-sixteenth century. For a long time, according to Villavicencio,

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[7] For a description of this trail see Manuel Villavicencio: Geografía de la República del Ecuador, New York, 1858, p. 138.

[8] William Jameson: Excursion Made from Quito to the River Napo, January to May, 1857, *Journ. Royal Geogr. Soc.*, Vol. 28, 1858, pp. 337–349; reference on p. 341.

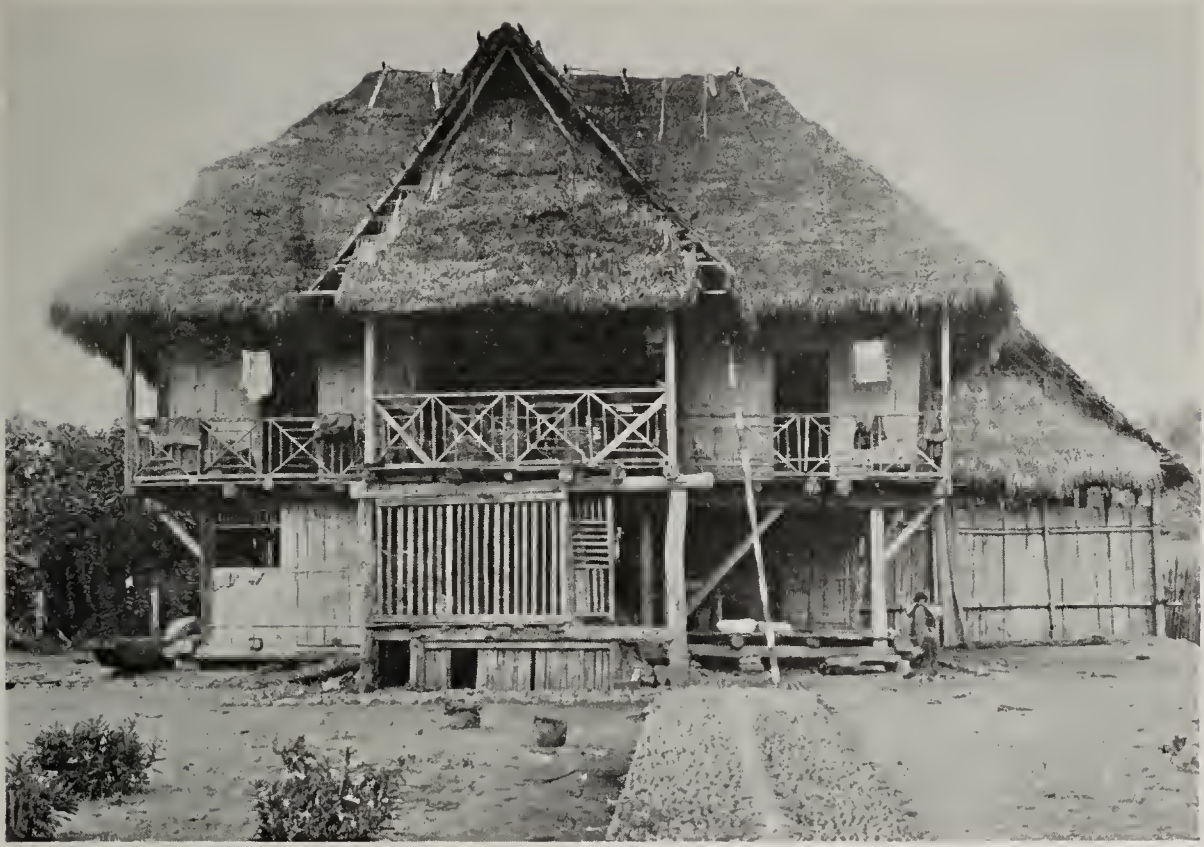

Fig. 6

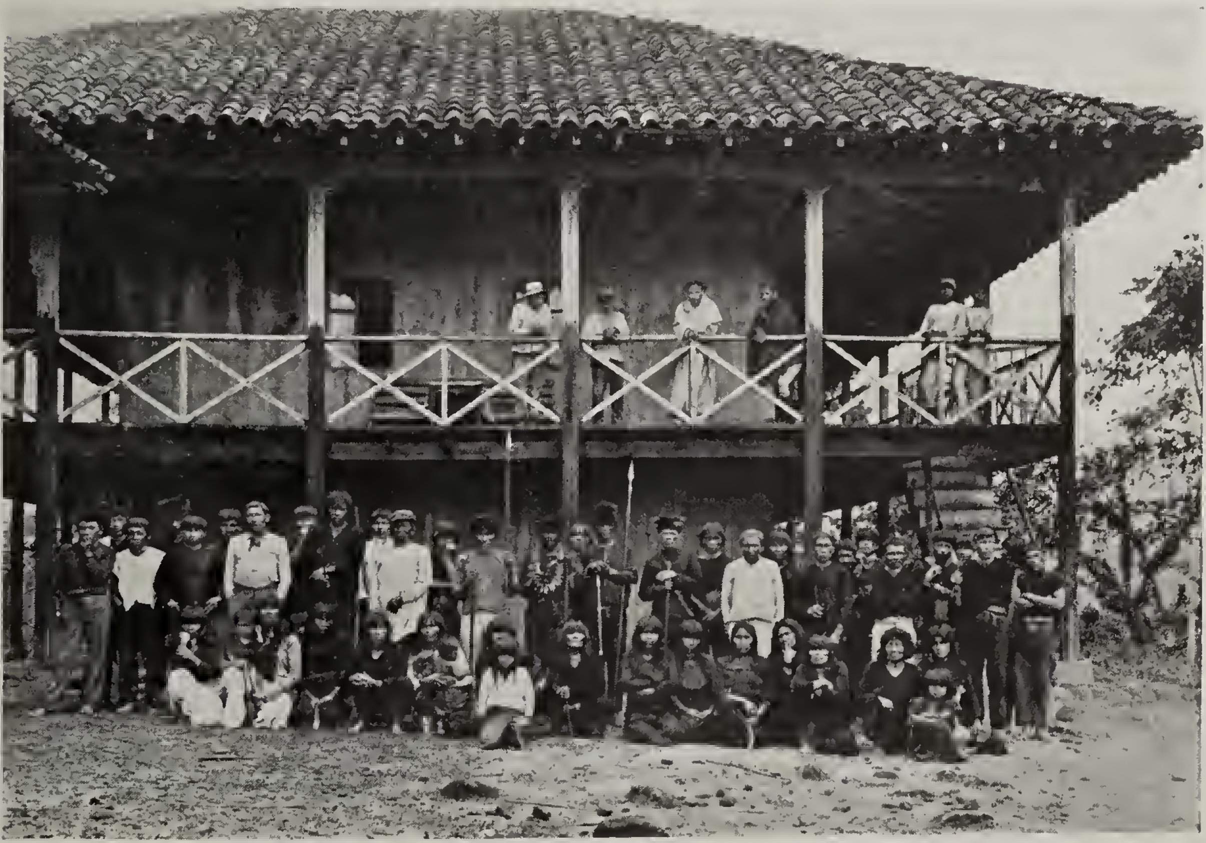

Fig. 7

Fig. 6—House of one of the settlers at Napo.

Fig. 7—Indians of Canelos in front of the Dominican mission house at Canelos.

it was the key to the Jesuit missions of the Marañon. In 1858 he describes it as having, besides the mission, no white resident but about 300 Indians residing near by in the forest. Today, however, there is no longer a mission station here, nor at Tena, nor at Napo. Archidona consists of four or five white families in as many houses arranged about a public square. Back of the houses and along the Quito trail are cleared pastures which make it a pleasant spot. The summits of the Andean Range dominate the view to the west of Archidona, and to the north rises the Cordillera Guacamayo. But the most striking mountain feature to be seen from Archidona is the great isolated cone of Sumaco, 28 miles to the north-northeast.

On October 1 we left Archidona on horseback by the Papallacta Trail and turned aside four miles north to follow on foot a newly cut trail eastward to the Rio Jandachi. The Jandachi we found to be a roaring torrent, 50 feet wide, occupying a narrow canyon, sunk to a depth of about 735 feet below the upland surface. We saw this stream again some miles farther north at the base of the Cordillera Guacamayo. The surface between Napo and the Cordillera Guacamayo is in general a dissected plateau rising in elevation from 2000 to 4000 feet at its contact with the wall of the Cordillera Guacamayo. A striking feature of the plateau surface is the presence of huge granite blocks, often as large as a house, lying on perfectly undisturbed sedimentary rocks. These may be erratics of glacial origin. The rocks of the plateau on the south side of the Jandachi valley terminate abruptly and without disturbance against the old granitic core of the Cordillera Guacamayo which rises to about 8000 feet above the sea. Further study will be necessary to work out the relations of the Cordillera Guacamayo, the Cordillera Galeras, and Mt. Sumaco to the surrounding sedimentary rocks. It is probable that the Cordillera Guacamayo is composed of granite and schist and is an offshoot of the Eastern Cordillera, the fault line of the Andes here making a salient to the east.

We did not ascend the Cordillera Guacamayo but returned the 26 miles to Napo and on October 17 started poling up the Napo and Anzu Rivers to Embarcadero, the terminus of our trail from Mera. and head of canoe navigation. From Embarcadero we traversed a short distance up the Rio Ila to a point where the red beds disappear beneath a basaltic lava flow near the base of the Eastern Cordillera of the Andes. This is a very interesting locality on account of the absence of disturbance or metamorphism in the red beds right up to the contact. This, together with the horizontal position of the limestones at the base of the Cordillera Guacamayo, is very striking and in sharp contrast to the contact on the western side of the Andes.

Survey from Napo to Canelos

The usual route from Napo to Canelos is by an old Indian trail to Puyo and thence via Indelyama to Canelos. We felt it necessary, however, to study the geological structure east of this route and decided to attempt a traverse through the jungle, although warned of dangerous Indians and the lack of a trail. On October 27 we left Napo, striking southeast. The surface is more dissected into sharp hills and ridges and has more streams than north of Napo. The first large stream encountered was the Puni-yacu which, although 150 feet wide, was shallow enough for us to ford. We reached the Rio Arajuno at a point where it is 200 feet wide. This, like the Napo, is divided into many branches and has a swift current of very clear water. We continued the traverse by stadia for some distance up the river bed, camping on October 29 at an Indian's hut. On November 1 we reached the Rio Curaray. The upland surface between the two rivers attains a maximum of 2040 feet above the sea and is well forested. The Curaray River is a winding, shallow creek about 30 feet wide and, where we left it, is 1815 feet above the sea. At one place on the river we found the ruins of an old Jesuit mission, only another indication that the upper Curaray, like much of the Oriente, at one time supported a larger population than at present. The interstream area between the Curaray and the next river south, the Rio Villano, is six miles wide, and the divide attains summits 2820 feet above the sea. We crossed the divide on November 5 and camped on the Rio Villano at an Indian hut 1740 feet above the sea. On November 6, crossing another upland of 2390 feet maximum elevation, we proceeded 12 miles to Canelos along the Rio Bobonaza. The 50 miles through the forest was without trail, and a large part of the journey consisted of wading in streams. Only three Indian huts were seen in all this distance.

Table III—Temperature Readings at Canelos (1690 Feet), 1921

Nov. 9	3.00 P. M.	76.1° F.	fair
Nov. 10	7.15 A. M.	68.0	cloudy
	8.15 A. M.	70.0	cloudy
	10.15 A. M.	72.0	cloudy
	noon	77.0	cloudy
	1.00 P. M.	78.0	cloudy
	2.15 P. M.	81.0	cloudy
	3.30 P. M.	81.0	cloudy
	6.00 P. M.	80.0	cloudy
	7.30 P. M.	76.0	cloudy
	8.30 P. M.	75.0	cloudy
Nov. 11	8.30 A. M.	72.0	fair
	10.00 A. M.	76.0	fair
	11.00 A. M.	80.0	fair
	1.00 P. M.	82.0	fair
	4.00 P. M.	80.0	fair
	6.30 P. M.	78.0	fair
	10.30 P. M.	70.0	fair
Nov. 12	6.30 A. M.	76.0	fair
	8.30 A. M.	68.0	cloudy, rain
	9.30 A. M.	67.0	cloudy, rain
	1.00 P. M.	72.0	cloudy, rain
	3.00 P. M.	73.0	fair

We found Canelos to consist of the residence and church of the Dominican Mission; a house used by a government official, vacant at the time of our visit; and the house of a white settler who has lived here with his family for many years. There were three priests at the mission, and while we were at Canelos a fourth arrived from Puyo. The mission, which has been maintained with periods of abandonment for at least 200 years, consists of two large, substantial buildings having red tile roofs—the finest buildings we saw in the Oriente. Father Leon, the present head of the mission, has been there 30 years. Canelos is situated on a beautiful plain overlooking the Rio Bobonaza at an elevation of 1690 feet above sea level. The settlement is surrounded by pastures and farms where one of the priests who is a farmer has fine cattle and raises excellent vegetables with which we were generously supplied. There are few mosquitoes and no malaria. During our stay the average daytime temperature was 75° F. with a maximum of 81° and a minimum of 68°. The small range of temperature is a striking characteristic of this entire country. Canelos is important as the terminus of one of the important land routes from Ambato via Baños, Mera, and Puyo to the Oriente; for here the Bobonaza becomes navigable, and canoes in ten days can reach the Pastaza at Andoas, head of navigation on that stream. The reason for crossing from Puyo on the Pastaza River to the Bobonaza is that the Rio Pastaza is not navigable for canoes for many miles below Puyo.

Table IV—Temperature Readings at Alapicos (3080 Feet), 1921

Nov. 20	3.15 P. M.	65.0° F.	rain
	4.00 P. M.	65.0	rain
	5.10 P. M.	64.0	rain
Nov. 21	6.00 A. M.	62.6	clear
	7.00 A. M.	63.5	clear
	noon	80.0	clear
Nov. 22	6.30 A. M.	68.0	fair
	1.15 P. M.	76.1	fair

Survey from Canelos to Alapicos

Thanks to the assistance of the Dominican Fathers we secured Indians to carry our packs and left Canelos on November 13 to survey the trail to Alapicos on the Rio Palora, a tributary of the Pastaza. We followed the Puyo trail for 12 miles to Indelyama, which consists of one or two Indian huts on the left bank of the Rio Pindo. At Indelyama the Pindo is 50 feet wide, about two feet deep, and very swift. Here we obtained two canoes and made a stadia traverse of the Rio Pindo to its confluence with the Rio Pastaza, a distance of about five miles. It proved to be a dangerous stream for canoeing on account of the bad rapids. The recently opened trail which follows the left bank should be used by all means.

The Pastaza at the mouth of the Pindo is divided into two channels, each 300 feet wide, separated by an island 1900 feet wide at low water.

The river is not navigable for many miles below this point; certainly the point of navigation would be well below the mouth of the Palora. The grade of the Pastaza between Ambato (8100 feet) and the mouth of the Alpa-yacu just below Mera (3800 feet), where the Pastaza comes out on to the Amazon plain, is one per cent, or 52.8 feet in the mile; between Mera and the mouth of the Pindo the grade is about 40 feet in the mile.

From the Pastaza to Alapicos the distance is 13 miles by trail, a large part of which is through water on account of the extraordinary number of small streams, the smallest of which is knee deep and 10 feet wide.

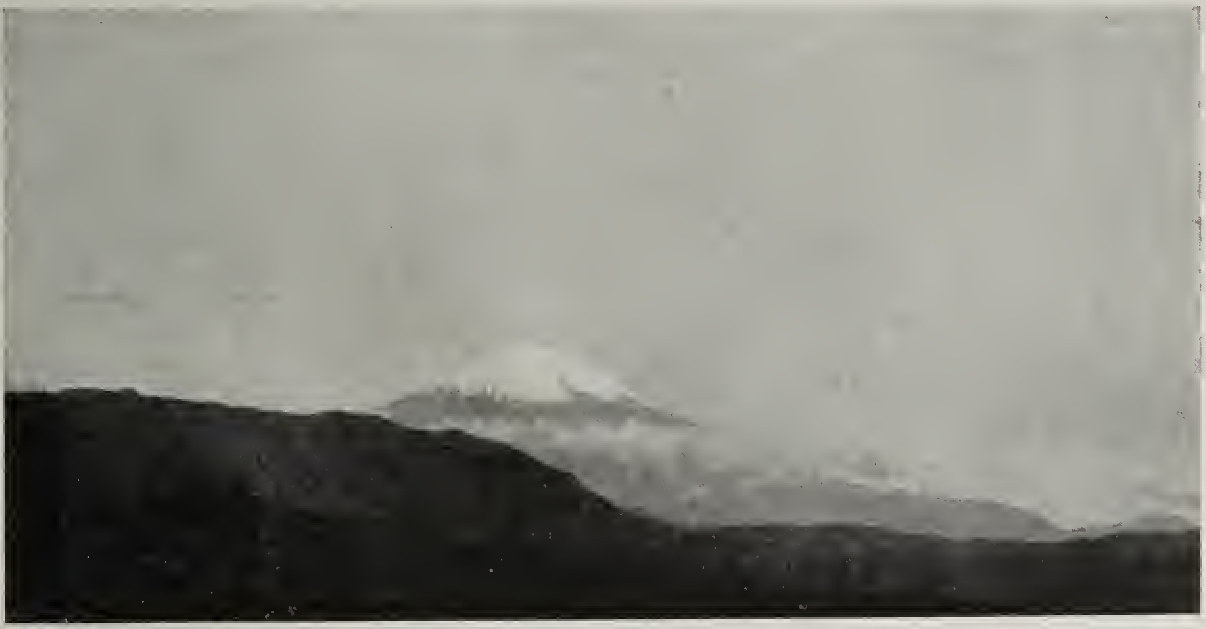

FIG. 8—The volcano Sangay (17,459 feet) seen from Macas at a distance of 26 miles. Wolf described Sangay as one of the most active of the world's volcanoes.

Alapicos is on the left bank of the Rio Palora at an elevation of 3080 feet and consists of one white Spanish-speaking family and a mission residence and church. There were no priests there at the time of our visit. The Indians in the vicinity are Jíbaros,[9] the Pastaza River being the boundary between these tribes and those speaking the Quechua language.

The dominating feature of the landscape at Alapicos is the great volcanic cone Sangay, 28 miles west, rising to an elevation of nearly 17,500 feet, with 2000 feet of its cone covered with perpetual snow. Of all the volcanic cones of the Andes seen by us Sangay stood first for perfection of form.

On November 23 we obtained canoes and crossed the Rio Palora, which is 300 feet wide and has a terrific current even at low water. Thence a traverse of 35 miles brought us to Macas. Our route lay across a jungle-covered, smooth-surfaced plateau of volcanic agglomerate. We passed three Jíbaro settlements, one of which consisted of four huts. In one of these the head of a woman was being reduced in accordance with the terrible practice engaged in by the people.

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[9] On the Jíbaros see J. L. Hermessen: A Journey on the Rio Zamora, Ecuador, *Geogr. Rev.*, Vol. 4, 1917, pp. 434–449.

Macas, Chief Town of the Oriente

Macas is a town of about 500 white people, the largest of the Oriente. It is situated on the south bank of the Upano River on a volcanic plain some 150 feet above the river bed, at an elevation of 3580 feet. It is several miles east of the base of the Cordillera Oriental, out of which the Upano emerges through a great canyon. Each house is in the center of a little farm. Owing to the fertility of the volcanic soil a large variety of foodstuffs is grown, and the region is famed for its magnificent cattle for which, however, there is no market. Macas, like the other towns, is exceptionally healthful; for there are no mosquitoes, the water supply is pure, and it is probable that the mean yearly temperature does not exceed 72° F. We were favored by a visit from the school children of Macas on the day after our arrival and were impressed by their intelligent faces, cleanliness, and healthiness. The Comandante, Sr. Manuel J. Bejarano, and his secretary made us welcome and gave us rooms in the house formerly occupied by Dominican priests. They assisted us in getting cargo carriers for the trip to Riobamba.

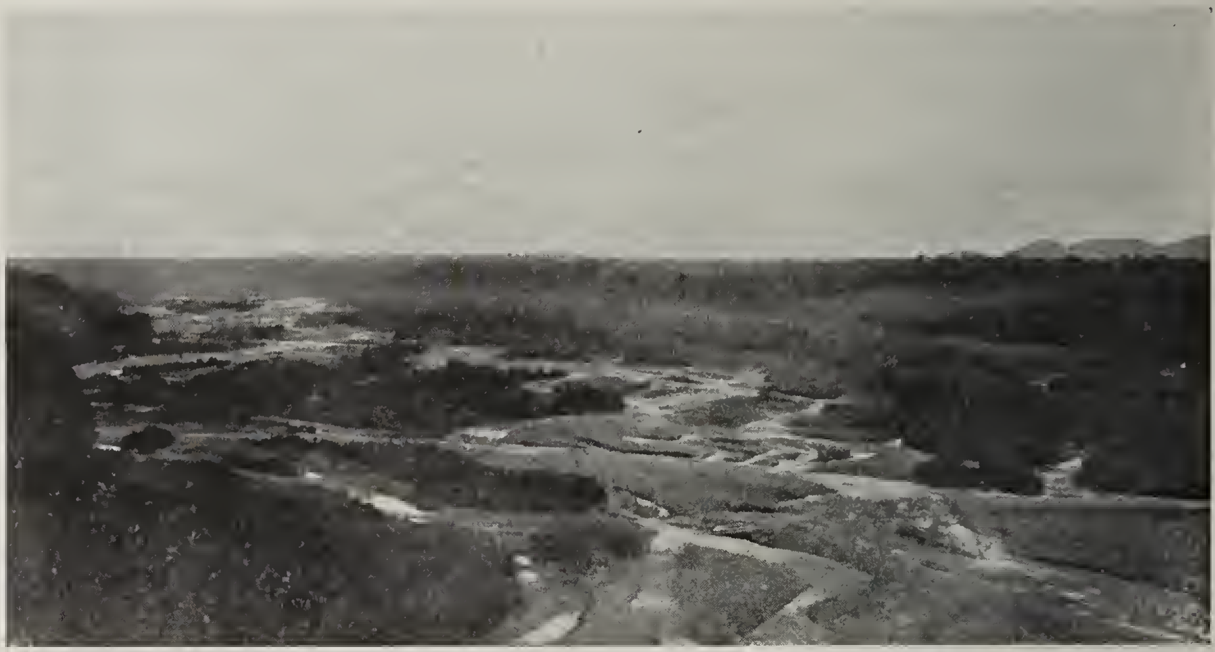


Fig. 9—A fine example of a braided stream. Looking up the Upano River from Macas (3580 feet). The stream bed is cut in a volcanic plain.

Across the river from Macas is the probable site of Sevilla de Oro, one of the famous montaña towns of the sixteenth century, of which today nothing remains except the mythical tales of its greatness. It is said that in the early days the Spaniards had a horseback trail all the way to Macas

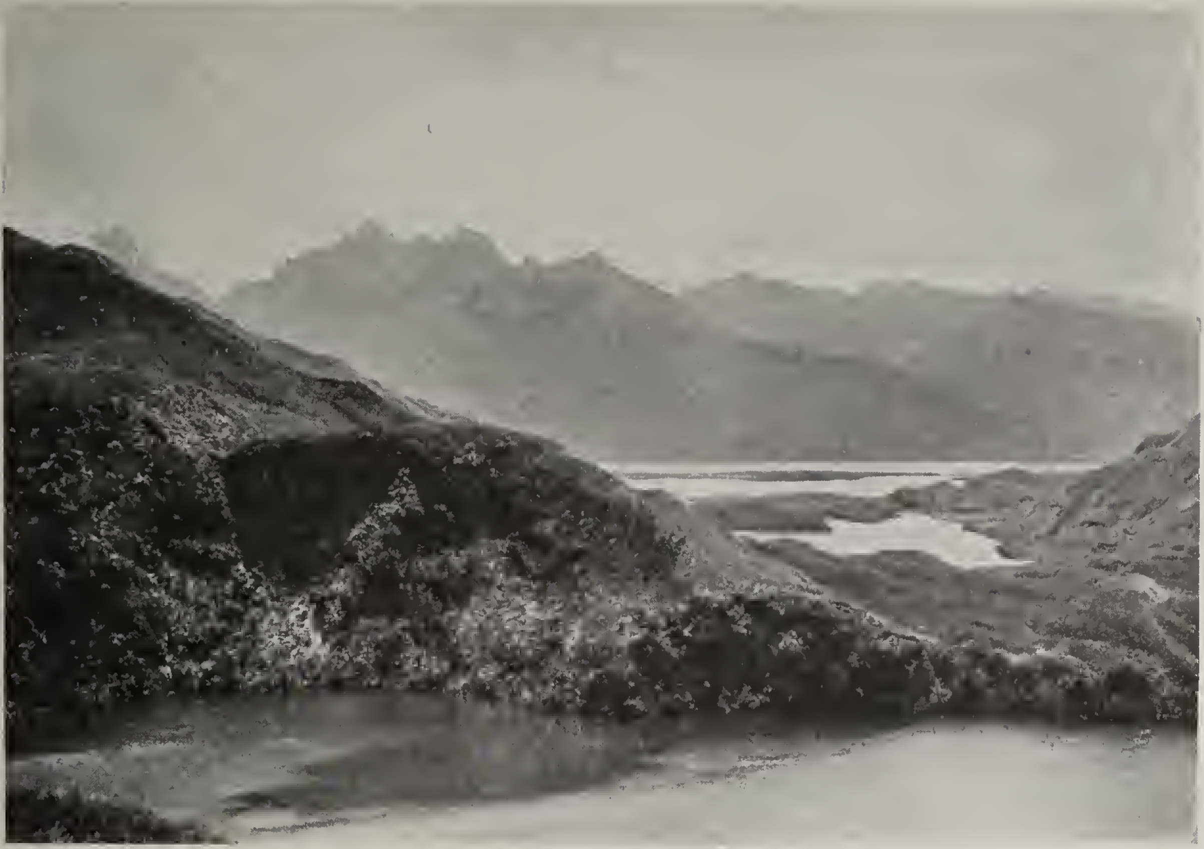


FIG. 10

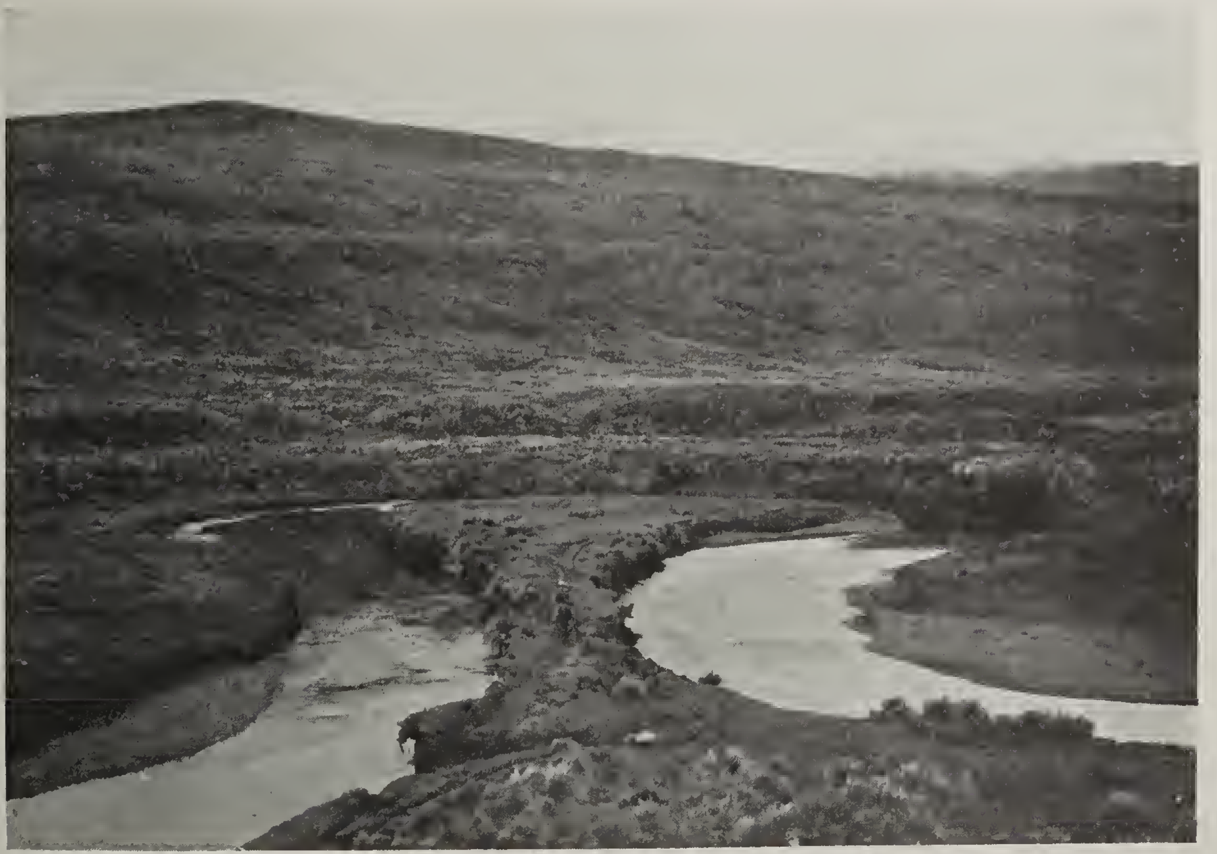


FIG. 11

FIG. 10—Andean lakes 12,000 feet above sea level: that in the background is the source of the Chambo River, affluent of the Pastaza, that in the foreground of the Upano River.

FIG. 11—Meanders in the Chambo valley. Typical *páramo* country, elevation over 11,000 feet.

from Riobamba on the Andean plateau, but today horses can be ridden from Riobamba only as far as Chanala, just east of the summit of the Andes, and should be taken only as far as the lakes at the head of the Upano River. The rest of the journey demands several days of wallowing in mud and of ascending and descending high ridges.

On December 2 we left Macas by the Upano Trail which, after following a swamp for a few miles, climbs up and down a succession of steep ridges. At times the trail narrows to a trench hardly wide enough for a man to pass through and is knee-deep in mud, with vertical walls 15 feet high, the result of many years of use and no repairs. On the fourth day of walking we reached the village of Chanala (8298 feet), the first settlement west of Macas, where about 20 whites and Indians live. Thence crossing over a pass 10,000 feet above the sea we reached the village of Zunac (9052 feet), occupied part of the year by the inhabitants of Chanala but deserted at the time of our arrival. Shortly beyond Zunac we finally emerged from the Amazon jungle at the foot of lofty cliffs up which two hours of climbing brought us to two lakes, Colay and Moctatlan, 12,000 feet above sea level, situated on the treeless *páramo*. We were at last on top of the Andes with snow-capped peaks about us. From this point we descended on horseback the Chambo valley to Riobamba, the end of our journey.

Summary of Topography

Some of the outstanding facts of the foregoing description may be briefly summarized.

In the Oriente the Amazon plain abuts abruptly against the base of the Eastern Cordillera of the Andes at elevations of 3800 feet near Mera, 3600 feet at Macas, 4100 feet at the base of the Cordillera Guacamayo—in general 4000 feet above sea level. Thence it slopes gently eastward, descending in a distance of 70 miles to a surface about 1000 feet above the sea at the mouth of the Rio Coca. Only a few relief features break the evenness of this surface: the Cordillera Guacamayo in the north with summits about 9000 feet above the sea; the Cordillera Galeras north of the Rio Napo, probably a residual range, whose summits reach 6000 feet; and, most striking feature of all, Mt. Sumaco, the great cone-shaped peak east of the Cordillera Guacamayo whose summit is 12,700 feet. The valleys have a maximum depth below the upper surface of 1000 feet, with interstream areas several miles wide. The rivers are all swift, torrential streams, navigable, if at all, only for Indian canoes, until they change to deep, sluggish, wide, muddy streams navigable for small steamers.

Climate

The limited time spent by us in the Oriente—four months, August to November—does not permit the formation of conclusions regarding climatic conditions through the year. It may be remarked, however, that temperature in the Oriente has a very small range, daily and annually. Rainfall, as well as altitude, affects the temperature, districts like Mera in the belt of maximum rainfall being cooler than corresponding elevations farther east.

There is a pronounced difference in the rainfall in the Oriente. The trades coming from the southeast are drying as they ascend the Rio Napo, but upon reaching the wall of the Andes and rising suddenly from 4000 to 18,000 feet they are suddenly cooled and give up their moisture. The belt of maximum precipitation in the region described in this paper lies approximately between the levels of Mera (3800 feet) and Baños (6000 feet) where it rains nearly every day. Below 4000 feet the rains were moderate at the time of our visit. It is reported that the months of September and November are the driest of the year. We have no records of actual rainfall in the Oriente except for Puyo, a few miles east of Mera, i. e. close to the belt of maximum rainfall at 3200 feet elevation. Martinez gives the following record for four months, year not stated: December, 8.7 inches; January, 12 inches; February, 18.4 inches; March, 13.7 inches. The annual total on the basis of these figures would amount to 150 inches. It is not surprising that there are fewer Indians living in the vicinity of Mera than eastward in the drier region about Canelos and Napo.

It was noted early in our work that barometric changes were very constant. Humboldt was the first to call attention to the uniform variation of atmospheric pressure in the equatorial regions of South America. He said that the time of day could be told by a barometric reading. High barometer is found at nine in the morning and low barometer at four in the afternoon. This was true every day regardless of the weather. However, when the pressures for several days have been plotted, the curve for a clear day will be approximately parallel with but above the curve for a rainy day. Nearly every day the afternoon low barometer was followed by rain which often lasted into the evening. Our barometric observations were taken in feet of elevation and were plotted showing the variation at Napo, Canelos, Alapicos, Macas, and intermediary points. These curves were very similar, and, after finding the law of variation, a correction table was made which was used throughout the survey whenever elevations were recorded.

MAGNETIC DECLINATION

At all important stations the magnetic declination was determined. In every case the compass needle pointed east of the true meridian. The declination for the chief localities was thus: Napo, 5° 43′ E.; Tena, 5° 43′ E.; Canelos, 5° 45′ E.; Alapicos, 6° 14′ E.; Macas, 6° 19′ E.

ANIMAL LIFE IN THE JUNGLE

While the purposes of the expedition were essentially geological and geographical, some notes may be made on the wild life of the region. While descending the Pastaza from Baños to Mera heavy rains prevented us from seeing more than an occasional bird. On the trail from Mera to Napo we first saw tracks of the tapir, which is the largest animal in this region. Around one of the camps at night a crashing of small trees and branches was heard. Inquiry among the carriers brought forth the information that a herd of tapirs was passing. Our first glimpse of this creature was when the Indians chased one into the Rio Napo below Venecia and speared it with wooden lances. They were so anxious to get at the meat that in a few minutes they had the carcass dismembered on the beach. It was as large as a small horse, probably weighing over one thousand pounds. The Indians gave us one of the quarters, but we found the meat tough. They, however, had a great feast on it. Tapir trails which we saw later were always in bottom lands near streams.

Deer tracks were observed throughout the region, and an animal was occasionally seen. They were dull gray in color and of good size. So much noise was made in the progress of our survey that it was impossible to get near them. This was true of many other animals. We saw the tracks and wallows of wild hogs but never came upon the animals. They are hunted by whites and Indians for their meat.

Two river animals which we saw were called by the natives *huanta* and *huatusa*. They are three-toed, tailless rodents with small front legs and powerful hind legs. The *huanta* is the larger, weighing fifty pounds or more, while the *huatusa* averages ten or fifteen pounds. Both are prized for their meat.

The one species of monkey encountered had a smooth black face and dark red fur and averaged perhaps thirty pounds in weight. We saw them first along the Anzu River above Napo and again on the trail from Napo to Canelos. The Indians and whites hunt them for food.

Our Indians shot two tree sloths near Canelos. They were shaggy, gray-green animals slightly heavier than the monkeys. They live entirely in the trees and because of their protective coloring and slow motions are not easily detected. Their green coloring is due to an organism which grows on the hair.

Another tree animal, the night-foraging honey bear or night monkey of the natives, was present around all our camps. His sharp, little, squeaky whistle was heard many nights before we learned the identity of the visitor. Our friends at Archidona gave us one which was quite tame. His sharp nose and long, ringed tail made him appear like the raccoon of our northern forests. The natives at Alapicos gave us the skin of an anteater, or ant-eating bear, which in size and color was like a small black bear. It has a long bushy tail of coarse excelsior-like hair.

Skins of jaguars, some of large size, were shown us in the towns; but we saw only an occasional track along the trail. The Indians of our party feared the "tigers," as they called them. It is probable that they are the most ferocious animals in the region.

Bats were common, and we slept under nets more as a protection from them than from mosquitoes. We saw horses and cattle which had been bitten by the vampire bat.

The Indians talked of snakes, particularly the water boa which haunts the rivers further east; but in our travels we saw none.

We were impressed by the almost total absence of birds from great jungle areas; day after day we traversed the trails seeing only a stray humming bird or hearing a pair of parrots scolding as they passed overhead. A kingfisher with a dull, orange breast was seen along the rivers, just as industrious and just as clattering as his northern brother. Toucans were sometimes seen in the jungle and around native houses, where they are kept as pets. Wild turkeys live along the smaller streams. On the lower Napo we saw a few condors. The Jíbaros around Macas showed us many small, highly colored birds which they shoot with blowguns. Most of these resemble orioles or finches. At Macas we saw for the first time swallows with black crosses on the under sides of their wings.

Population

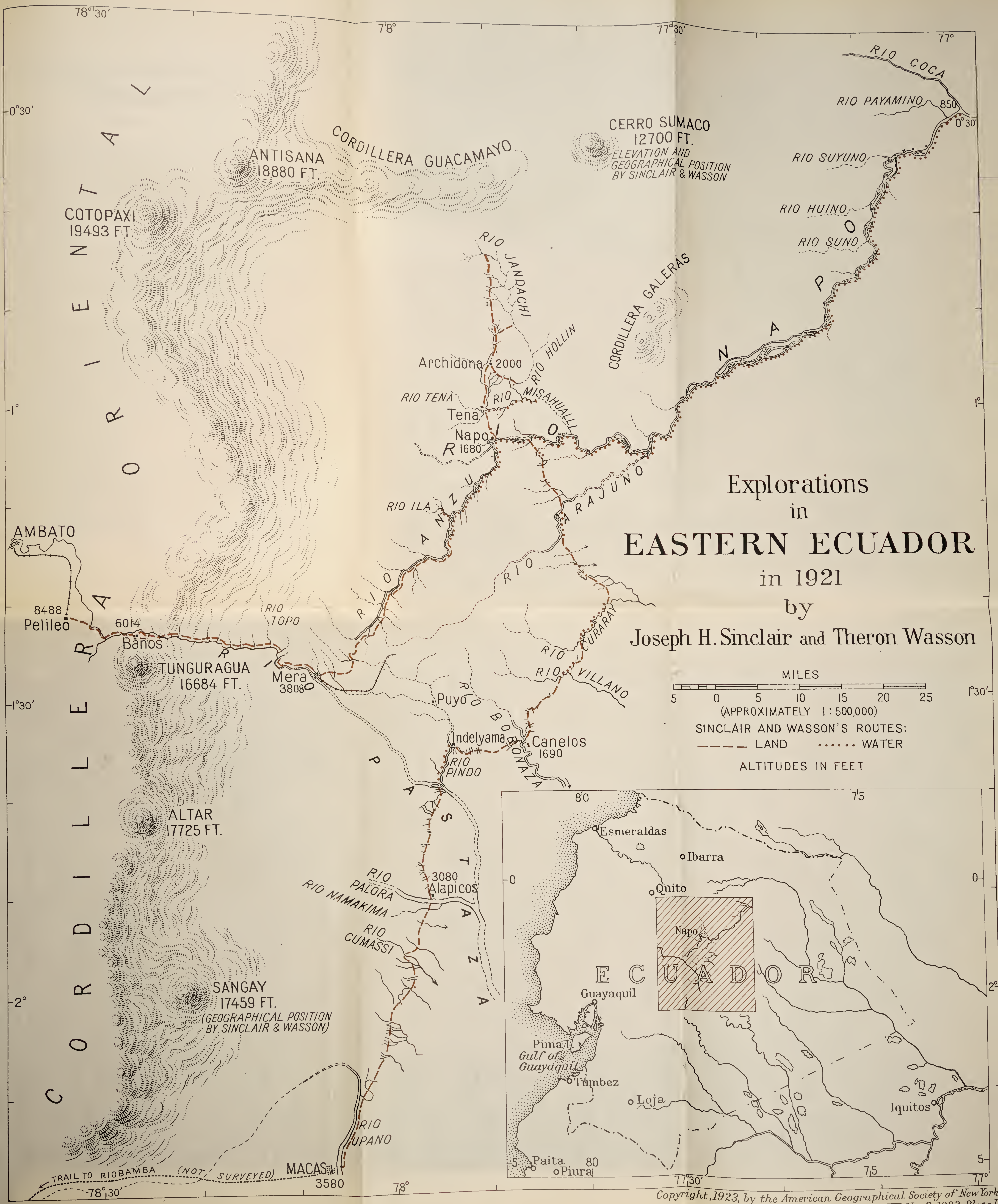
The Pastaza River is the dividing line between Indian tribes who speak different languages. The Quechua-speaking Indians live north of the river and are known as "Napo" Indians, "Canelos" Indians, etc., according to the name of the white settlement near which they reside. A characteristic of these Indians, as well as of the Jíbaros further south, is the fact that they have no villages. They live along streams, each family separated from the next. Near the white settlements, however, their huts, while continuing to be hidden in the jungle, are closer together. At Canelos, for example, the village consists of two or three houses of whites; not an Indian is to be seen. But on following dim trails radiating out from the settlement the homes of the Indians will be found. This lack of community life carries with it a corresponding lack of social organization, and, although there are chiefs, they are individuals who exercise only vague authority. The Indians for the most part are under the patronage of whites, whom they call "patrons." Each white man exercises a sphere of influence over as many Indians as he can, and the rivalry between white men is rather keen, bitterness arising in case of conflict over the patronage of Indians. In return for the protection offered by the white the Indian will now and then do some work, especially in carrying supplies to and from Quito or in washing gold from stream gravels. The number of Indians is small, and it is difficult to induce them to work. The use of Indian labor to any large extent is, in the writers' opinion, out of the question; construction of railways, pipe lines, highways, etc., will have to depend on white labor brought down from cities, such as Baños and Ambato, and in all probability on labor imported from the West Indies or some other region, as was done during the construction of the Guayaquil and Quito Railway.

The Jíbaros south of the Pastaza hold no allegiance to white masters and are in many ways superior to the Quechuas. They have strong, clean bodies and intelligent faces. They go armed with the deadly blowgun and long lances bearing iron heads. The men weave a good grade of cloth made from homespun cotton. They build strong houses of hard black palm, for each family is a unit and the house is a fort as well as a home. Sometimes twenty or thirty people live under one roof. They have gardens of yuca, plantain, papaya, and small red peppers. Polygamy is practiced. The name headhunter is applied to them from their practice of reducing the heads of enemies. These are used in ceremonial dances and for personal adornment. A great deal of the fighting between families is due to the witch doctors, who are called in to determine who has bewitched a sick person.

The Jíbaros who gathered at Alapicos to look over our outfit came from curiosity. They were not disposed to work, and we had nothing in the way of cloth or trinkets which would induce them to carry loads to Macas. They became interested when they learned that our guide had two small, stone jars of the black poison which they prize so highly for their blowgun darts. This poison is brought into the country by Indians from northern Peru where the secret formula is known. Our guide, Sr. Rivadeneyra, had obtained the poison from an Indian just as he arrived from Peru. The Jíbaros carried our equipment to Macas, a trip of eight days. Each Indian received about a teaspoonful of the black, sticky poison and felt well paid.

The white inhabitants are Spanish-speaking people who have migrated from the highlands of Ecuador. One of the striking features of these people is the fact that, though situated among Indians, they have preserved their purity of race. The total population of whites in the region from Archidona to Macas cannot exceed 600, and almost all of these are living in the town of Macas. This town is a unique settlement, located at an elevation of 3580 feet above the sea, distant eight days from the upland civilization by the most difficult travel on foot, in mud, and up mountainous cliffs. It is a town of perhaps 100 houses and nearly 500 people, cut off almost entirely from the civilization of the upland. Without commerce and communication, one wonders why this or any of the other such settlements continues to exist; yet their history dates back to the early settlement of South America by the Spaniards. Perhaps it can be explained by healthful conditions and the agricultural productivity of the region.

The great drawback of civilized development in eastern Ecuador is the lack of railways. The future depends on one thing, the continuation of the railway from Pelileo down the great natural gateway to the Oriente, the Pastaza River, and on the construction of branches north and south along the base of the Andes from a point like Mera. The Upano Trail and the Papallacta Trail are impossible routes of communication, being unfit for highway or railway construction.



Explorations
in
EASTERN ECUADOR
in 1921
by
Joseph H. Sinclair and Theron Wasson

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THE SAPO MOUNTAINS AND THE SAMBÚ VALLEY

A BIOLOGICAL RECONNAISSANCE IN SOUTHEASTERN PANAMA

By T. Barbour and W. S. Brooks

Southeastern Panama is not easy of access. Regular communication between the city of Panama and Darien ceased some years ago with the closing down of the gold mine at Santa Cruz de Cana. This famous old mine, the source of "infinite wealth" in earlier colonial days had been reopened towards the end of the last century, and while it was in operation there was steamboat service between the capital and the chief settlements—the village of Yavisa on the Rio Chucunaque and El Real de Santa Maria and other small towns on the Rio Tuyra. From Marragantí, the head of steamboat navigation, canoes were taken for Boca de Cupe, whence a small railway of sorts extended forty miles to the mine.

Today communication with the exterior is generally limited to the great *carricaballo* dugout schooners which still bring bananas to Panama from the coast ports of Darien.[1] These vessels, however, sail very badly, are miserably handled, and make poor time on their coastwise voyages. Once in a while an auxiliary schooner makes a trip to La Palma at the mouth of the Tuyra estuary.

Nor is any amelioration in prospect. Since, owing to chicanery and bad management, the Cana mine has closed, the population of the Tuyra valley has dwindled. The constantly shrinking price of ivory nuts has also played its part in the economic decline of the region, making more miserable the unhappy lot of the scattered and neglected population of negroes and mestizos who form what may be called the Panamanian population of the extreme eastern portion of the country. The ruling classes who reside in the capital consider any visit to the provinces as arduous or even dangerous and have no desire to explore. Even within a few score miles of the canal locks at Gatun and Miraflores are large areas populated with primitive Indians and almost, if not really, less known than they were during the days of the early *conquistadores*.

To the biologist eastern Panama offers almost a virgin terrain. Only two parties of naturalists have previously worked here. E. A. Goldman, of the United States Biological Survey, with a Costa Rican assistant, spent some months of fruitful collecting on the slopes of Mt. Pirre and the headwaters of the Rio Tuyra, using the mines at Cana as a most convenient

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[1] Compare T. O. Selfridge: Reports of Explorations and Surveys to Ascertain the Practicability of a Ship-Canal Between the Atlantic and Pacific Oceans by the Way of the Isthmus of Darien, Washington, D. C., 1874, p. 162.

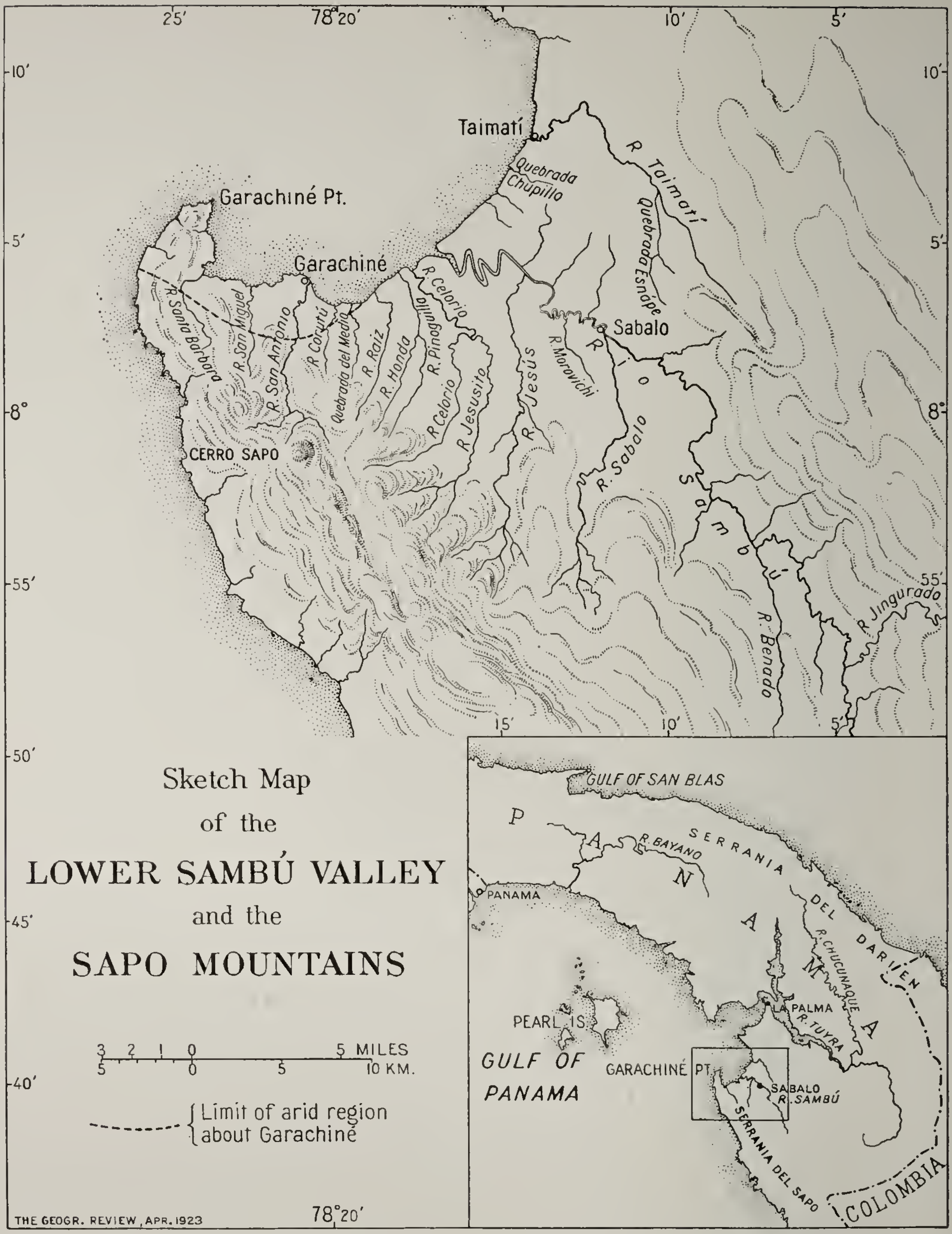

Fig. 1—Sketch map of the lower Sambú Valley and the northern part of the Sapo Mountains drawn from observations by the authors and data supplied by Colonel Morrell. Scale approximately 1:430,000. The general location is shown on the inset map.

base.[2] A little later a party from the American Museum of Natural History, led by the veteran W. B. Richardson, secured additional collections from the valley of the Chucunaque, reaching Mt. Tatarcuna on the summit of the divide.[3] In the first half of 1922 the writers undertook a biological reconnaissance in the territory west of the Tuyra basin—in the valley of the Sambú and the Sapo mountains.

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[2] E. A. Goldman: Mammals of Panama, *Smithsonian Misc. Colls.*, Vol. 69, No. 5, Washington, D. C. 1920. See abstract with map in the *Geogr. Rev.*, Vol. 10, 1920, pp. 267–268.

From Panama to Garachiné

When we arrived in Panama in the month of March, we were discouraged to find that an opportunity to reach Garachiné, the village near the mouth of the Sambú River, without loss of time seemed very remote. After days spent in idle inquiry we received the news from our old friend Don Pablo Pinel that the auxiliary schooner *Chiriquí* had been chartered by the government for a trip directly to Garachiné itself. Thanks to the kindness of Dr. Porras, the President of Panama, whom we approached through Dr. R. P. Strong, Chief of the Gorgas Memorial Institute for Medical Research, we were allowed passage on this vessel. Her mission was to carry the Ministers of Interior and Finance to adjudicate disputed oil claims in the coastal region of the Gulf of San Miguel.

Sailing from Panama one afternoon we spent the night in our cots on the deck of the *Chiriquí*, waking only from time to time to watch the unrivaled phosphorescence for which the great Gulf of Panama is celebrated. At daylight we were off Iguana Island and by ten were at anchor off Garachiné. Garachiné has no harbor but nevertheless is well protected by the high and arid headland of La Punta de Garachiné. This point and the plain on which the town is situated lie in a small, isolated zone of very sparse rainfall, the moisture being precipitated from the trade winds by the high peak of Mt. Sapo proper (4000–5000 feet), the westerly outpost of the Sapo range, which lies about ten miles inland from the village. Mt. Sapo is covered with high rain forest which extends in all its luxuriant splendor over the whole Sambú valley and reaches the coast at the mouths of the Taimatí and Sambú Rivers but a few miles north of the semiarid Garachiné Point with its sparse, scrawny forest of white-barked *cuipo* trees.

We made no attempt to climb Mt. Sapo itself; but from a spur, called La Jarcia, above one of our camps (1700 feet) we got several splendid views of the range, which can also be clearly observed at times from the sea. It is our belief that, although the Cerro de Sapo is currently believed to be the highest point of the range, in reality there are several peaks which exceed it in height, lying some thirty or forty miles southeastward and not far from the Colombian frontier.

The village of Garachiné lies on a burning, treeless stretch of shingle, which at low tide is fronted by an enormous expanse of stinking mud flats. The town is ill-favored in the extreme, pestilential and half deserted. There are possibly three hundred inhabitants although, some say owing to a misconception in the capital as to its size, it boasts five schools which function intermittently. To one familiar with village life or architecture in Panama, Garachiné presents no novelty or attraction, and we were not sorry to embark our equipment in the little launch, which we had towed from Panama, and start for the Sambú. The launch took us to the head of navigation, dropped us ashore, and returned at once to Garachiné and Panama.

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[3] H. E. Anthony: Panama Mammals Collected in 1914–1915, *Bull. Amer. Museum of Nat. Hist.*, Vol. 35, 1916, pp. 357–376. See the striking photograph of the forest-clad Mt. Tatarcuna (*not* Tacarcuna), Figure 1.

THE SAMBÚ RIVER

The lower reaches of the Sambú are flanked by high mangrove forests which gradually give way to a varied growth of hardwoods as the banks rise slightly higher. As on the other rivers draining the Pacific slope of eastern Panama, the great rise and fall of the tide is felt many miles inland and really controls possible navigation. We steamed up the river on the swiftly rising tide to the head of navigation at the junction of the Sabalo with the Sambú, where we disembarked our gear.

The main stream of the Sambú has been ascended by one or two white persons as far as Boca de Sabalo and once, by Major Maulsbury of the Canal Zone Survey, to the Rio Pavarondó. His object was to fix certain points for the Panama Gulf Oil Company, and we owe to Colonel Morrell of that company the opportunity to use these fixed points and other data in preparing our sketch map, which shows at least approximately the true relations of the Sambú tributaries with the Sapo range—relations which on previous maps have been very incorrectly drawn. Except for these journeys on the main stream of the Sambú there seems to have been no exploration by white men of the affluent rivers and the Sapo hinterland.

SYNOPSIS OF THE TRIP

Our purpose was zoölogical, not geographical, exploration; so that the intimate details of our work day by day need not be dwelt upon. Suffice it to say that we made our first camp on the Quebrada Esnape, a tributary of the Rio Taimatí, several hours' march northeast of Boca de Sabalo. Here we spent several days; but, finding the rainfall excessive and reptiles very scarce, we retraced our steps and marched from the Sabalo mouth across to the upper reaches of the Rio Jesús—a long, arduous tramp through dark, stifling, and very boggy forest. From the house of the Indian Churima, where we passed the night, we marched to the Rio Jesusito and then by stages ascended this stream to where it entered a wide gorge in the Sapo range. We made excursions in various directions using our upper Jesusito camp as a base. Our next move was to return to the house of Churima on the Jesús and then take dugouts and descend the river—a long day's drag and paddle—to the junction of the Jesús and the Sambú; here, caught by night, we were forced to camp in the low forest, muddier even than elsewhere. The following day we reëntered Garachiné, paid off our Indians, and engaged a crew of Panamanians—most worthless fellows; with them, or rather in spite of them, we managed to move our equipment up the valley of the San Antonio to the lower slopes of Mt. Sapo. From this camp we made excursions in various directions and finally, our provisions having again run short, returned to Garachiné and chanced to find a small 22-foot gasoline launch, belonging to an itinerant official. Chartered at an exorbitant price, this leaky and wholly unseaworthy craft finally brought us to Panama again. This journey was the most dangerous feature of the entire trip.

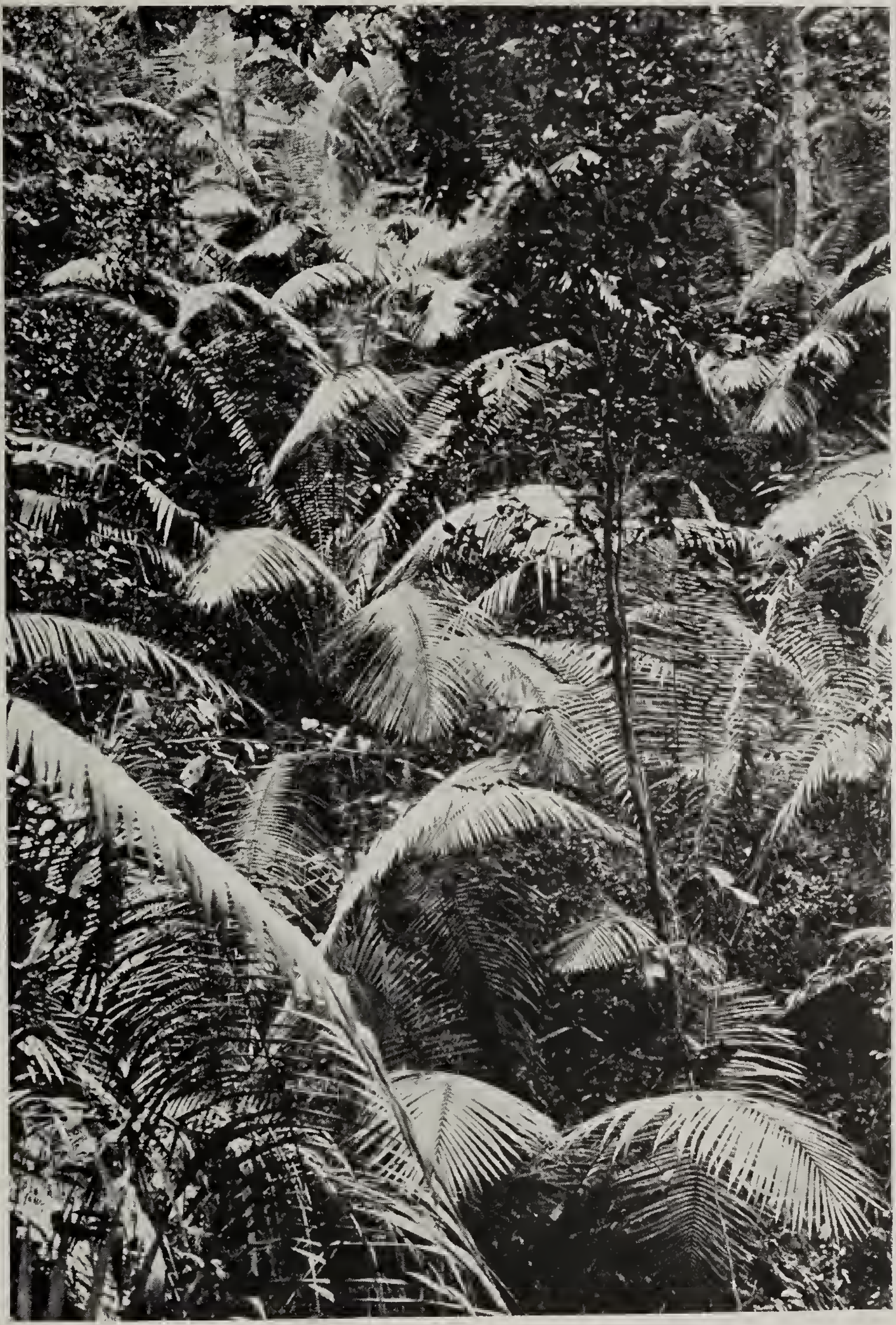

FIG. 2—A pure stand of ivory nut palms on the slopes of Mt. Sapo. This hillside could be ascended only by proceeding on "all fours" and pulling oneself from tree to tree.

The Chocoano Indians

Perhaps the most valuable advice received on our trip was that given us by Major Maulsbury when he said, "Keep asking for the Indian Juicio; he talks Spanish and is wholly reliable." We began to encounter the naked Indians working in their clearings along the Sambú, beginning perhaps ten miles from its mouth. They were decidedly undemonstrative at the unaccustomed sight of our launch and paid little heed to our shouted messages. However, Major Maulsbury, who was in the launch, was recognized. He was much beloved by the Indians, and we had not been many hours at Boca de Sabalo before Juicio stepped into the circle of our firelight with four of his friends.

Contrary to the many stories we had heard, we found the Indians not only friendly, after the ice was once broken, but honest, industrious, and wholly interested helpers. Several became most trusted advisers and friends. In all respects the Indians proved a marked contrast to the shiftless Panamanians who presume to despise them.

The Indians of eastern Panama belong to two groups, the Cuna Indians, who live along the Darien divide and who inhabit part of the Caribbean littoral—the San Blas coast, for instance[4]—and the Choco, Chocoi, or more correctly the Chocoano, Indians.[5] These two peoples have managed to persist uncontaminated to this day by different but equally successful means. The Cunas have been bold and ferocious warriors and still forbid whites from ascending the Chucunaque beyond the mouth of the Membrillo. It is probable, however, that a party of Americans could go anywhere in this territory, given a little time to establish relations. The Chocoano people extend over a larger area and have survived by retiring before any visitors and living in their forest fastnesses far from outside contact. They, nevertheless, used their arrows, poisoned with the skin secretion of a venomous tree frog (*Dendrobates*), to good advantage. Today many possess antique firearms and are ashamed to confess that they own a bow and arrows, although actually these are still in use.

It is impossible to estimate the number of Chocoans in Panamanian territory; they occupy a portion of the Colombian territory of the Choco as well. Their houses are not grouped in villages but are scattered, always on some river or stream bank, throughout not only the whole Sambú and Taimatí valleys but also on many of the other rivers as well. They have no permanent habitations in the Sapo highlands and go there only to make canoes or to hunt.

Their Houses and Method of Life

Their houses are in general similar in type. Placed on posts about five feet from the ground, the floors are made of the split trunks of the Iriartea palm; and the roof, sloping four ways from a ridgepole some ten or twelve feet in length, is of palm thatch. The space under the roof and well above the heads of the occupants is devoted to the storage of domestic articles and dancing and hunting gear. There are no walls. A notched tree trunk serves as a stairway. In one corner a square of four logs filled in with packed clay serves as a fireplace. The firewood is always laid on end to end, and the point of juncture of the six or eight sticks thus gradually being consumed serves to support the large earthen pot in which the cooking is done. Green bananas are roasted by removing the peel and standing them upright in the embers. They are scraped before being eaten. The Chocoans make excellent pottery of varied forms. Their basketry exhibits much originality of design and shows a knowledge of many types of plaiting and weaving.

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[4] Compare S. P. Verner: The San Blas Indians of Panama, *Geogr. Rev.*, Vol. 10, 1920, pp. 23–30.

[5] The Panamanians speak locally of "Cholos Chocoanos," "Cholo" being the local word for Indian and having a different significance from the Bolivian usage.

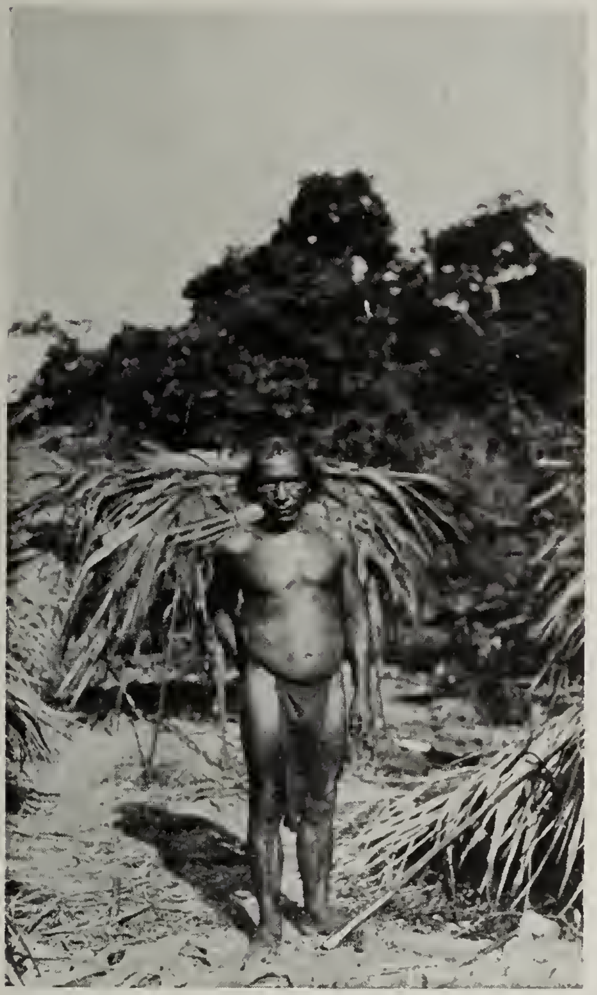

FIG. 3

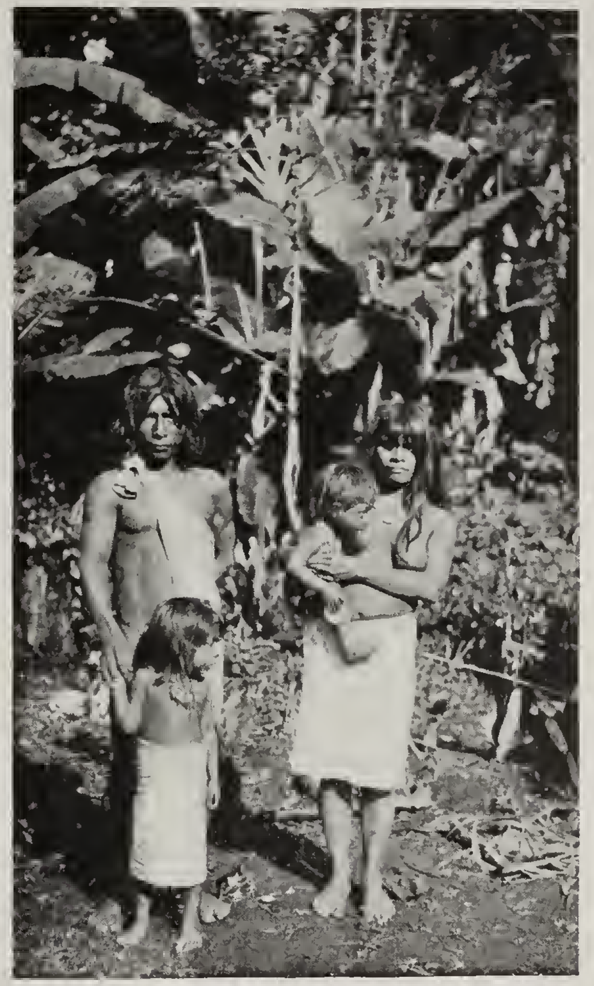

FIG. 4

FIG. 3—A Chocoano Indian. One of our most trustworthy hunters before a temporary shelter on the lower Rio Jesusito.

FIG. 4—Chocoano Indians. Our friend Churima, his wife, and children.

Groves of banana plants surround all their dwelling places and grow with splendid luxuriance. A little maize and a little upland rice are cultivated; but in general bananas, boiled or roasted and always cooked green, together with game and especially fish form their staple food. In fishing the Chocoans use a long lance of beautifully polished palm wood and spear the sluggish catfish which swim near the surface of the deep, muddy streams. In the swift, clear waters they hunt the fish which lurk among rocks or in holes in the banks, using a knife to cripple them. Since firearms came into use, game has become scarce. The condition of mammals brought to camp gave every evidence that the hunters approached to within a very few feet of their quarry. Being more used to bows than firearms, the hunters hold the rifle or single-barreled shotgun in an unusual manner. The left hand, holding the grip and trigger, is extended at arm's length; the right hand, grasping the butt plate, takes the recoil. Possessed of great skill in woodcraft, wonderful vision, and almost unbelievable endurance, the Chocoans are rapidly reducing the numbers of tapir, deer, and peccary. However, they eat any mammal down to the size of a rat and many birds, so that they have a varied diet.

Their Customs and Habits

The men wear a narrow loin cloth and show great fondness for bodily decoration. A wild fruit, the annatto, having a carmine juice, is used in conjunction with soot; and face, body, and thighs are elaborately decorated with stripes and lattice designs in red and black. After the invariable morning bath—the men swim fully as well as Polynesians—fresh orchids or some other conspicuous flowers are stuck through the lobes of their ears, and pollen and loose flower leaves are sprinkled on their heads. The nature of our work prevented our observing the natives in ceremonial attire or during festivities. Their hair as a rule was cropped, although this appears not to accord with Mr. Pittier's observations.[6] The Chocoans are short in stature—from five feet, three inches to five feet, seven inches in height; but they are well built, graceful, and lithe. No old men or old women were seen.

The women are well treated but are rather kept in the background until one is on terms of intimacy with the men folk. They are clean and well formed and wear a single narrow skirt. They were never observed to paint their faces or bodies, although we were told that they do so for feasts and dances. Mr. Pittier states that the women of this tribe preserve their "good looks" longer than most primitive women. The impossibility of ascertaining their ages renders statements of this sort very vague. The children are loaded with beads and of course usually wear no clothes until well grown. Children are numerous, and all appear well nourished. Their hair often presents a rusty appearance not seen in the adults. Apparently the whole Chocoano population has a high immunity to malaria, although at present a few suffer from the local relapsing fever. Since they scrupulously avoid contact with the Panamanians there is little or no venereal disease.

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[6] Henry Pittier: Little-Known Parts of Panama, *Natl. Geogr. Mag.*, Vol. 23, 1912, pp. 627–662; reference on p. 659.

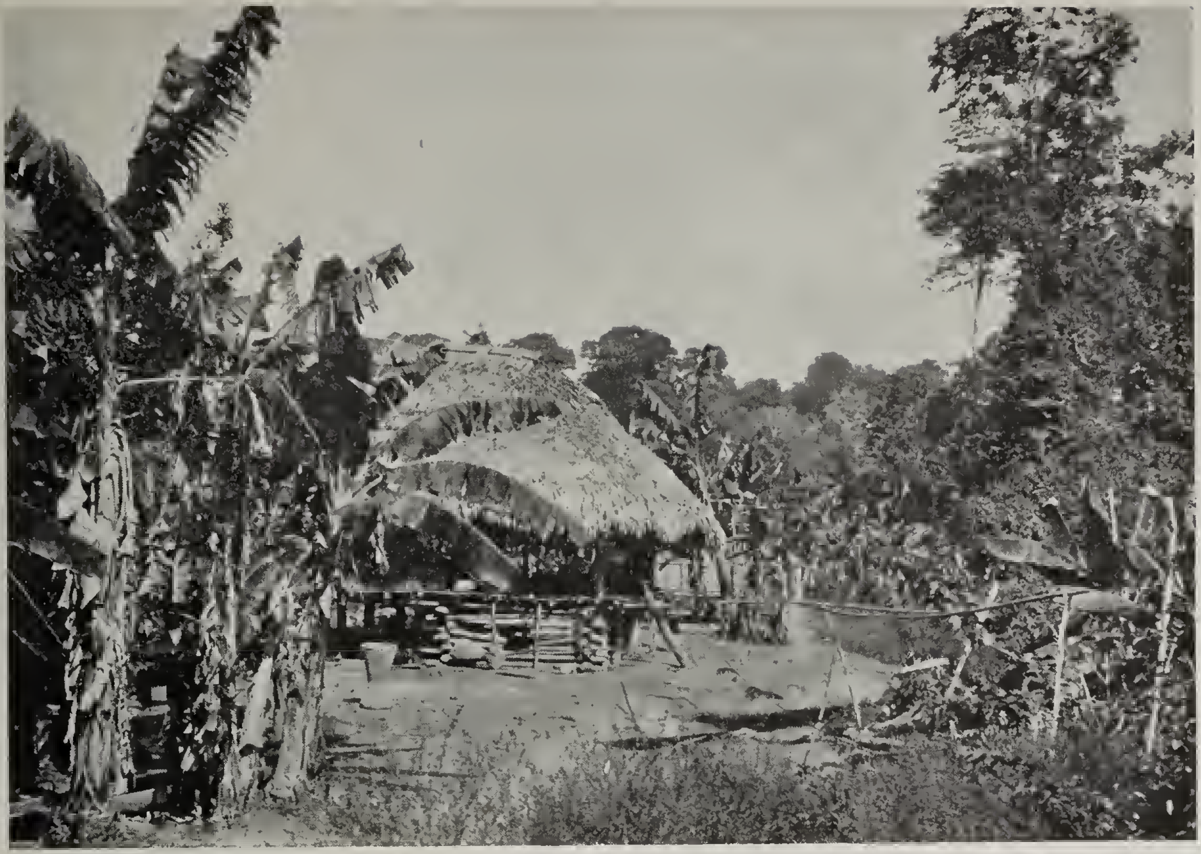

FIG. 5

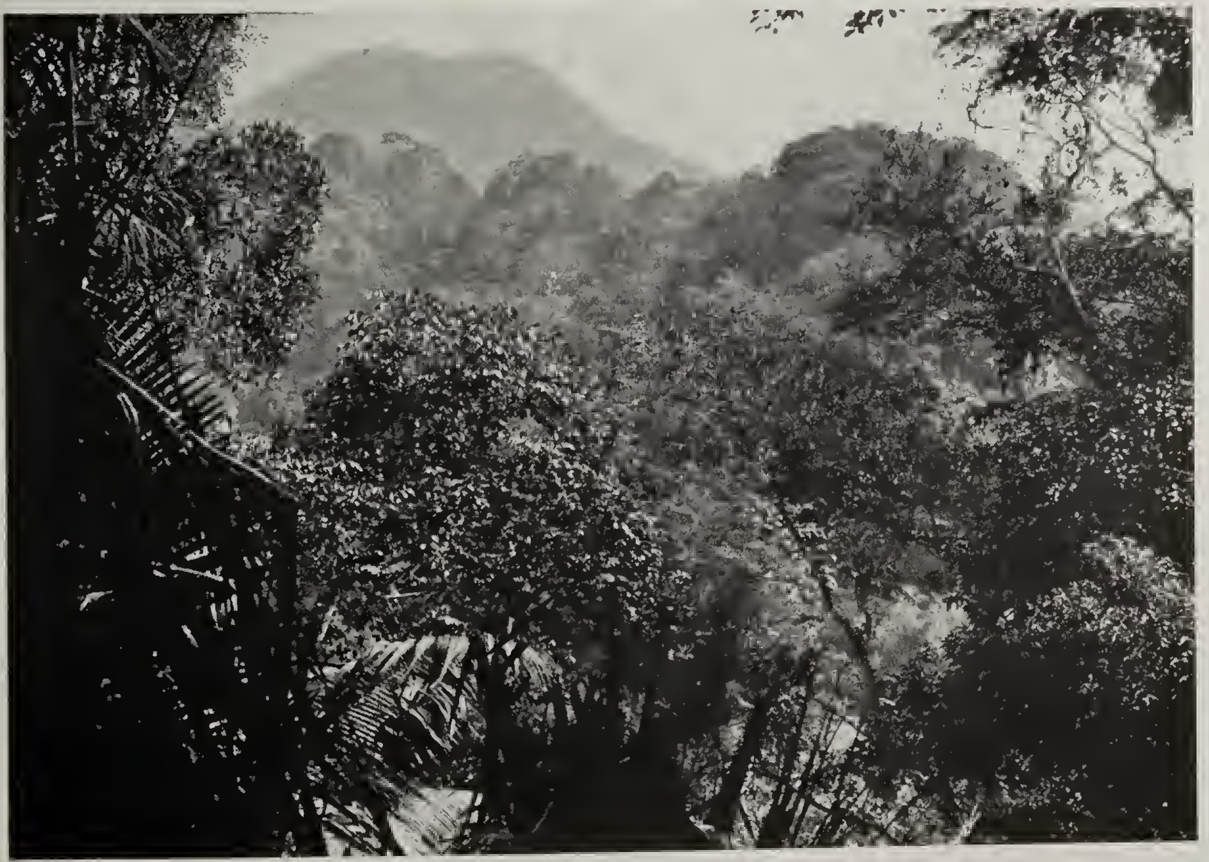

FIG. 6

FIG. 5—Indian house in a plantation of bananas on the Rio Sambú.

FIG. 6—View of the summit of the Cerro de Sapo from a clearing made on the neighboring ridge La Jarcia. Looking west-southwest.

SANITARY PRECAUTIONS OF THE EXPEDITION

The lowlands of the whole Darien region are notoriously unhealthful, and, as we suffered no ill effects from our sojourn, a few words as to our equipment may be of interest. Our drinking water was all purified in a forty-gallon Lister bag obtained through the kind interest of Dr. Strong and Major Bocock of the Army Medical Corps. Our open-front tent had a mosquito curtain drop in the doorway, which was considered sufficient protection when we were camped far from human habitation and where the mosquitos were probably not infected. The period of metamorphosis of the parasite in the salivary gland of the mosquito is ten days, so that mosquitos becoming infected, as they undoubtedly did after biting our carriers, would become capable of transmitting malaria in that time. We therefore moved camp several miles at least every ten days. We had spe-

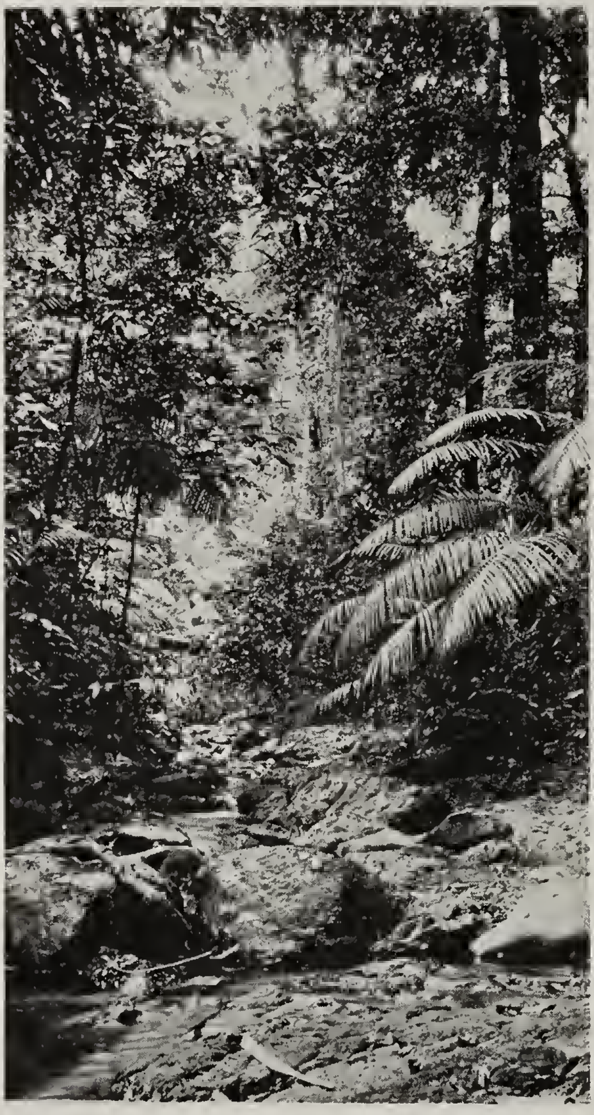

FIG. 7

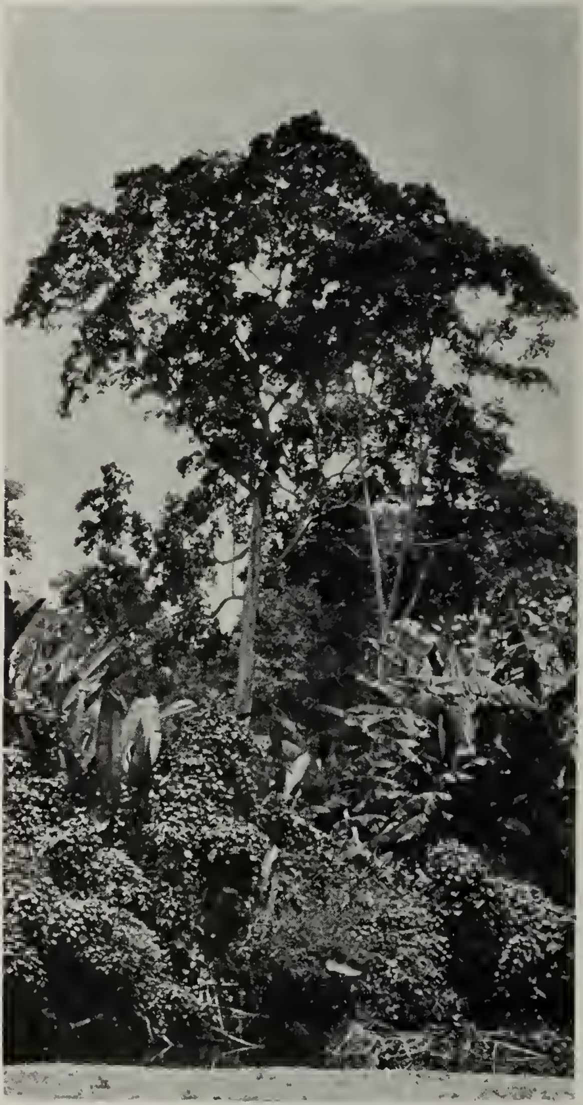

FIG. 8

FIG. 7—The extreme headwaters of the Rio San Antonio. This photograph was obtained by a twenty-one-second exposure on a cloudy day.

FIG. 8—Vegetation in the lowlands of the Sambú. An abandoned Indian plantation.

cially made mosquito bars for use over our cots when sleeping in native huts or in our forest huts, for we ordinarily used the tent to keep our powder, food, and specimens dry. These mosquito bars had balloon silk waterproof tops which extended down about four inches on the sides; below this was sewed a zone of heavy bobbinet; and below this was a wide strip of heavy unbleached muslin with a deep hem. A light floorcloth prevented the entrance of mosquitos from below when we were in a cane-floored hut. In the woods we ran a heavy pole through the hems of our *mosquiteras* which kept them close to the soft ground. Anopheles begin to fly at dusk, so that we habitually ate an early supper and then got under our mosquito bars to put in an overlong night, rendered doubly tedious by the stifling heat within the bar. At daybreak we waited until we observed that the Anopheles resting on the bobbinet had all flown away, and then we emerged. We followed this very uncomfortable and perhaps over-cautious régime without exception, even where we believed the mosquitos were not infected. About our highest camp on the slopes of Sapo there were no Anopheles, and we smoked our after-supper pipes out of doors in great enjoyment. One point in setting up the mosquito bar is of prime importance. It should flare as widely as possible when hung, in order to lessen the probability of the sleeper's moving during the night so that arms or feet come in contact with the net and thus permit the Anopheles to bite through the mesh.

Food Supply

We carried Burroughs and Wellcome tea tablets and many types of dehydrated and compressed food, which served excellently well. We were unfortunate, however, in finding that our Indian companions were short of food themselves. Disastrous floods before our arrival had played havoc with their lowland plantations. To persuade them to carry for us, when in reality they wanted to replant, it was necessary for us to share our food with our large party. This resulted in our running very short while on the upper Jesusito where we found large game much scarcer than we had expected. Our Indians stood by us loyally, for usually they do not travel in such large companies; but for a long time afterward we felt the ill effects of a diet of green bananas and such rat and monkey meat as we were able to procure. The extreme heat and constant rain made it almost impossible to keep venison and wild pork from spoiling, although we carried a hundred pounds of salt. In any case meat never lasted long, since, when deer or peccaries came in, the Indians ate enormously and considerately sent salted meat by a runner to their wives at home.

Vegetation of the Region

The climate of Darien approaches that of the western Colombian region (Chocó) of very heavy rainfall.[7] The forest throughout the Sambú valley is of the heaviest rain-forest type, high, deep, and dark. Wherever the light penetrates, as along water courses, there is abundant growth of scattered palms of many species. Within the density of the high woods the *palmae* are less conspicuous although they are to be found everywhere. Over large areas of bottom land and along steep, sharp ridges as well, great areas of ivory nut palms occur almost always in clear stands unmixed with other species. The ivory nut palm (*Phytelephas*)—locally called *tagua*, and the groves *taguales*—grows much more luxuriantly in the wet lowlands than on the better-drained slopes and makes a dark, gloomy wood, the floor of bare slimy mud with molds growing actively except where the rain often floods the forest floor. The *monte alto*, as the deciduous woods are called, is hard to penetrate not because the dense undergrowth cannot be avoided—for it can, as it grows only where light penetrates—but because the tree trunks are close together and the great vegetable hawsers of tangled *bejucales* run up and down and from tree to tree in unbelievable confusion. They form the usual highways for monkeys, squirrels, many other small rodents and many creeping birds—far safer than the ground.

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[7] Compare Goldman, *op. cit.*, p. 22, "In much of the Darien region the total rainfall is increased to an annual precipitation of perhaps more than 200 inches, which renders this area one of the wettest in America."

The forest along the Jesusito is the finest we have ever seen, finer than may be seen in Java, the Moluccas, Papua, or the Organ Mountains of Brazil. We cannot compare it with the great Amazonian or the Congo forests; but, while it is of far smaller extent, we cannot believe that it is not equally high and varied. As is usual, the green forest roof is overtopped by isolated giants which, when they happen to be of flowering species, stand out in gorgeous contrast to the wide roof of varied green. Our lookout, cleared on one of the elevated spurs of Mt. Sapo, revealed many vivid species in flower. The Sapo range, as has been indicated, cuts the moisture-laden winds off from Garachiné and its sheltering peninsula, and here the vegetation is semi-xerophytic and in striking contrast to the region inland. The point of Garachiné is covered with open woods looking quite white from a distance since the white-barked *cuipo* trees (*Cavanillesia*) abound to the exclusion of most other species. About the town itself there is some pasturing of cattle, and in the pasture lands acacias remind one of the *potreros* of Cuba.

THE LAPPS IN SWEDEN

By K. B. Wiklund
University of Upsala

From early times two essentially different peoples, different in origin, in language, and in civilization, have lived side by side in northern Sweden—the Swedes and the Lapps. Reasons for conflict have not been wanting, naturally, between these two peoples; but at the same time, with some rare exceptions, these conflicts have not been so acute and tragic as in the majority of similar cases in other parts of the world. During the course of time agricultural, and latterly industrial, penetration has carried the Swedes far up into the country of the Lapps; and, strange as it may sound, the Lapps also with their reindeer have penetrated far into the ancient territory of the Swedes. As to culture, naturally it is the Swedes who have been the givers; but the Lapps, although they have adopted much from modern civilization, still contrive to retain at least the material side of their own old culture. The Lapps are now and have been for hundreds of years good Swedish citizens and fully conscious of their Swedish nationality. For instance those Swedish Lapps whose wanderings take them for a part of the year into Norwegian territory always call themselves "Swedes." However, the indebtedness is not all on the side of the Lapps. The Swedes are and long must be dependent in some important respects upon their weaker Lapp brethren and their work.

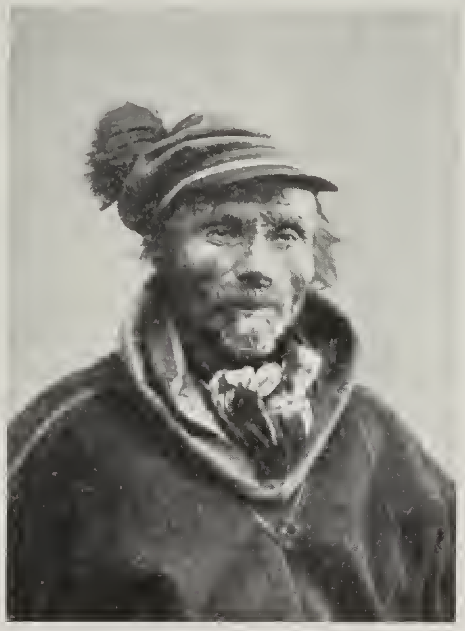

Fig. 1—Old Lapp. This and the following photographs are from Jukkasjärvi and Karesuando, the most northerly parishes in Swedish Lapland.

Origin of the Lapps

Anthropologically classification of the Lapps is doubtful. It is usually said that they are "Mongol" or "Mongoloid;" but little is gained by this term, because there is no certainty that there is or ever has been a "Mongol race."[1] At present one can only say that the Lapps, where preserved in comparative purity, are a people distinguished by short stature, very brachycephalic heads, light complexion with somewhat of a yellowish brown tint, brown eyes and dark or quite black straight hair. The face is very broad, the chin often poorly developed; but the eyes are not "Mongol," i. e. oblique. Physically the Lapps are thus sharply differentiated from both the Scandinavians and the Finns. Temperamental differences are at least as marked, even if these are less easily defined. The Lapps, however, like the Finns speak a Finno-Ugric language. At some time, certainly more than 2000 years ago, they perhaps adopted it from a neighboring superior Finno-Ugric people, presumably the forefathers of the Finns of the present day; but during the ages intervening the languages of Finns and Lapps have developed along such different lines that mutual understanding long ago became impossible. The Lapp language has furthermore developed into a large number of different dialects so specialized that they too, to a large extent, are mutually incomprehensible. At the present time,within the borders of Sweden alone, the several dialects may be considered as constituting three different languages. When Swedish Lapps from more distant districts meet, they use Swedish as the medium of communication.

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[1] Recently an interesting attempt has been made by H. Bryn to group the Lapps and the Samoyeds together as a Palearctic race, *Ymer*, Vol. 22, 1922, p. 350.

It is not known what language the Lapps spoke before they adopted their present vernacular, and therefore it is not possible to show by linguistic means their anthropological affinities. All that is certain is that they immigrated to the Scandinavian peninsula from the northeast and that before they did so they were to be found as far south as central and southern Finland and in the neighboring parts of Russia, even as far as the great lakes Saima and Onega. From whence they had come to these last-mentioned districts is not known. Probably, as primitive hunters and fishermen, they had followed the inland ice as it shrank northward, but whether they pushed forward from the southwest, from the south, or from the southeast is not known.

Lapp Migrations into the Scandinavian Peninsula

From the earliest times the reindeer has played a vital part in the Lapp economy, at first as the chief game hunted, later under domestication. Taming of the reindeer seems to have begun only when the Lapps had reached the mountain districts in the northernmost parts of Finland and Scandinavia. At first, it appears, the tamed deer were used for bearing burdens and drawing sledges, work previously done by human power, perhaps with the help of dogs. Later, small herds were formed and maintained as a food resource. Use of reindeer milk and method of milking were evidently learned by the Lapps from the Scandinavians. There does not seem to have been any direct connection between the Lapp method of reindeer management and that obtaining in Siberia, the westernmost offshoot of which is found among the Samoyeds on the tundras of northeastern European Russia.[2]

The date of the first contact of Lapps and Scandinavians has been established by linguistic means. It took place about the middle of the millennium preceding the Christian era and presumably in the most northerly part of what is now Norway. Knowledge of iron and its use had just reached these northern districts, and the Lapps learned both name and usage from the advancing Scandinavians. From this time onward a great number of other culture elements, material and mental, began to pass to the Lapps from their new neighbors and were evidently accepted by them with avidity. The old Scandinavian names for all these elements, preserved by the Lapps with admirable fidelity, bear witness to these movements. Other testimony to these cultural relations is found in the ancient pagan religion of the Lapps which, according to sources dating from the seventeenth and eighteenth centuries, had early absorbed a great many ideas from Scandinavian paganism and later on from Christianity.

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[2] On reindeer culture among the Samoyeds and other Siberian tribes see H. U. Hall: A Siberian Wilderness: Native Life on the Lower Yenisei, *Geogr. Rev.*, Vol. 5, 1918, pp. 1–21.

During the course of time their migrations carried the Lapps and their reindeer herds farther and farther into the Scandinavian peninsula. Along the mountains and through the great forests of the interior they moved progressively southward. At about latitude 66° N., they seem, even before the time of the Vikings, to have had occasional encounters with a presumably sparse Scandinavian population which then inhabited this region but which afterwards for some unknown cause moved away. During the Middle Ages the Lapps reached the 65th parallel. In the sixteenth century they began to appear in the mountains as far south as 64° and in the next century 63°, even in districts which had long been inhabited by a Swedish peasantry. Occasionally single families would be seen as far as 62°; but the Lapps and their herds did not obtain a permanent footing so far south until about 1880.

THE "MOUNTAIN" LAPPS AND THEIR MIGRATIONS

The nomadic, or so-called Mountain Lapps, who during the summer are to be found with their reindeer on the treeless mountains in the west, during the autumn move down to the forest districts in the east, where the reindeer find the lichen, reindeer moss. This is their principal winter food: in the summer their chief fodder consists of certain species of grass and of leaves. Actually, following the lay of the land and the course of the rivers, this yearly migration is a movement back and forth between northwest and southeast. In the southeast the Mountain Lapps in some districts come in contact with the so-called Forest Lapps, whose reindeer are of another race than those of the Mountain Lapps and who stay in the forests the whole year round. While the chief occupation of the Mountain Lapps for ages has been management of the reindeer, Forest Lapps were formerly chiefly employed in fishing and hunting. Latterly this has been considerably altered. In some cases their small reindeer herds have increased; in others agriculture has become their chief occupation. In many districts they have given up reindeer breeding entirely and have become peasants or have succumbed to poverty and disappeared.

Apparently in early times, before reindeer breeding had reached any great development, the Lapps were divided into small tribes whose territories were defined by natural boundaries from those of neighboring tribes. These territories in turn were divided into smaller tracts, to which the several families composing the tribe had exclusive rights. The whole of the tribe would gather together during midwinter at a more or less fixed center; but during the rest of the year the different families lived dispersed, each beside its own fishing waters and on its own hunting ground. Capturing of the wild reindeer, i. e. the principal form of the hunt, was carried on collectively and communally; otherwise, as a rule, every family fished and hunted on its own account. But with the development of mountain reindeer management things became more complicated. In certain mountain tracts, for instance, it was difficult to maintain any division into individual districts for reindeer breeding, and it also soon became necessary, owing to the increasing size of the herds, for the Mountain Lapps to extend their winter ranges. These, however, were already occupied by other Lapps, the forefathers of the Forest Lapps, whose mode of life seems to reflect an earlier period in the history of this people. The Mountain Lapps were thus compelled to rent grazing land for their herds with the Forest Lapps and at last to seek more land beyond the territory of the Forest Lapps and even to make furtive occupation of forest districts settled by Swedish peasants in the coastal regions. The result was a movement towards the coast in the southeast as well as along the mountain ridges towards the south. All this is in direct opposition to the commonly held supposition that the Lapps were the original inhabitants of large parts of Sweden and that they have been driven towards the north and west by the advancing Swedes. Presumably it is only north of the 65th parallel, where certain special local names point to an original Lapp population probably of the fisher and hunter type, that one can say they have been driven back from the coast.

The present eastern boundary of the province of Lapland which was fixed about 1750 A. D. shows a limit which the Lapps with their reindeer herds could only transgress in secret. Since then, however, they have succeeded in gradually pushing their way east of this boundary during the winter as far as the coast from Luleå to the south of Sundsvall, between 65° 30′ and 62°, where they have won a prescriptive right of occupation during the winter season. It is in fact a remarkable example of how a nomad people, almost in our own times, can under favorable circumstances push its way into the midst of an agricultural community.[3]

Political and Legal Status of Lapland and the Lapps

For long the great wastes of the north were considered by the Swedish crown as *res nullius*. During the sixteenth century some attempt was

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[3] An example analogous, in a way, of the capability of a nomadic mountain people to push its way forward to great distances and, as we may say, to filter through territory belonging to other nations, is to be found in the advance of the Rumanians in the Carpathians as far as Wallachisch-Meseritsch in Moravia, and in the Balkan Peninsula into northern Greece.

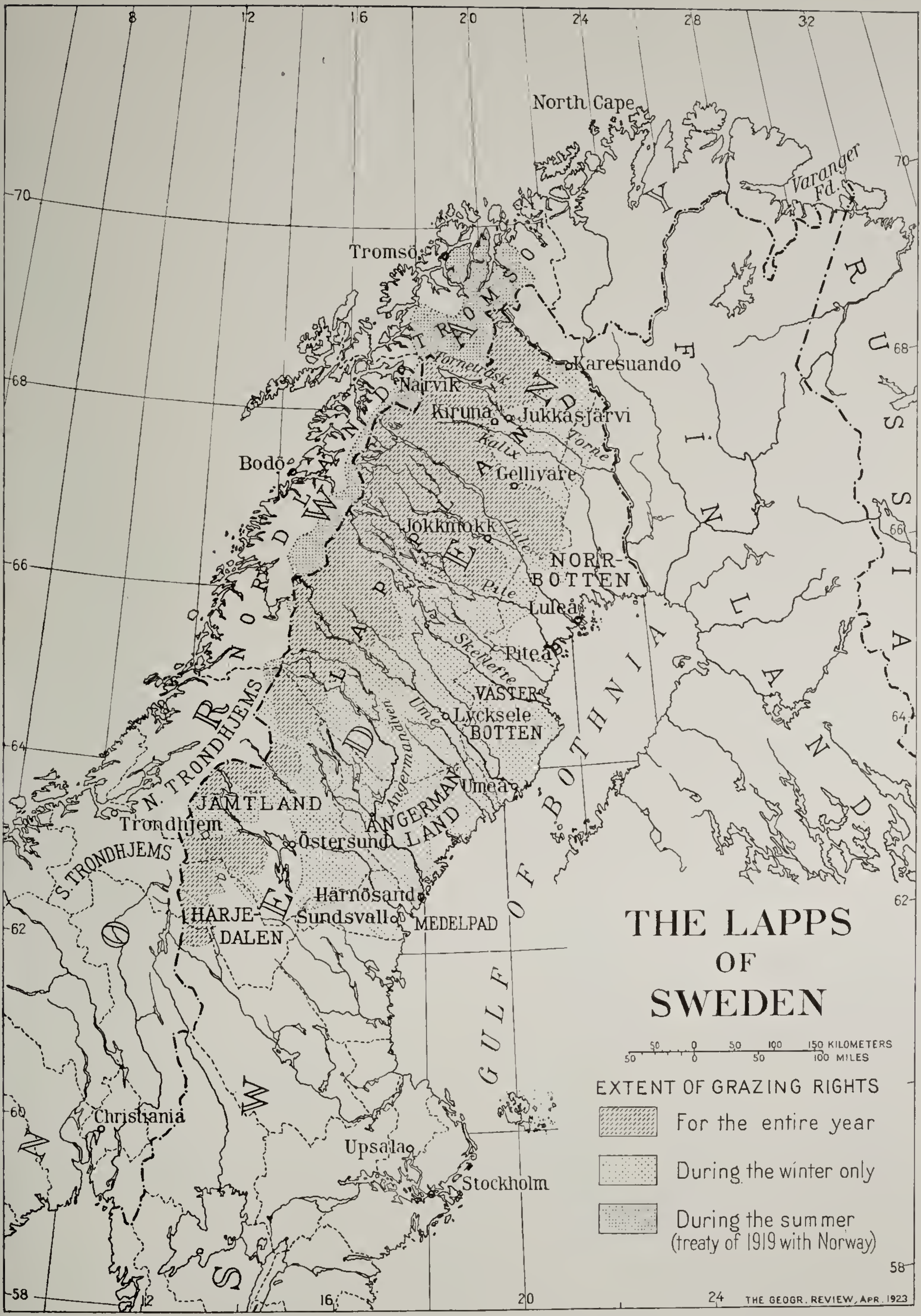

Fig. 2—Sketch map showing grazing lands of Swedish Lapps at various seasons of the year. Scale of map approximately 1:9,500,000.

made to fix the status of these lands as the property of king and state, a status that was definitely established during the following century, since when the Lapps as a matter of fact have only possessed the right of use and not of ownership of their country. From the end of the seventeenth century inclusive, with the advance of cultivation in Lapland, this situation became of great and decisive consequence for the Lapps, as the crown, especially in order to support the important mining industries which had arisen here and there in the mountain districts, encouraged the creation of new settlements. At the same time care has been taken, in practice as well as theory, that the Lapps shall be disturbed as little as possible. The settler must look after his own farm, and he is given only such forestry and fishing rights as are strictly necessary. Furthermore, many Lapps become settlers. With the consent of the authorities, and after individual investigation of each case, they can settle down like the Swedes and cultivate the soil within their prescriptive lands.

During the second half of the nineteenth century, owing to increasing cultivation, the Lapps began to be more and more cramped for room. Gradually, almost imperceptibly, important pasturage became difficult of access or useless to them. Reindeer damage the meadows and hay of the settlers; they also do a good deal of injury in the forests, a consideration of importance as the value of the forests increases. Difficulties soon began to arise, moreover, in connection with certain of the Swedish Mountain Lapps' ancient and prescriptive right of moving to territories which now belong to Norway or Finland.

In early times the country of the Lapps was *res nullius* to the extent that no foreign ruler had made any claim upon it; but already, during the times of the Vikings, the Norwegians had begun more or less systematically to collect "taxes" from the Lapps in what is now northernmost Norway and among the mountains lying about its borders. Not long after, perhaps simultaneously, Finnish trading companies on the shores of the Bothnian Gulf had settled at the mouths of the Kemi, Torne, Lule, and Pite Rivers, whence they began to exploit the hinterland and to collect "taxes" on behalf of themselves or the Swedish crown. The wanderings of the Mountain Lapps, however, continued and were directed as before by the instinct of the mountain reindeer, which led them during the summer to the grass-covered and mosquito-free mountains on the present Swedish-Norwegian boundary or, in certain districts, to the shores of the Atlantic Ocean and the islands belonging to the present district of Tromsö (Tromsö amt, or Troms *fylke* as the official designation now is). The present boundary between Sweden and Norway, which taken as a whole follows the course of the watershed, was not fixed until 1751. In 1809 Sweden together with Finland ceded the wedge of land to the northwest of the latter country to Russia. But the Lapps with their reindeer could not be confined within these boundaries and be prevented from following their old routes without great risk of starving to death. For humanitarian reasons, in the treaty of 1751 respecting the boundaries, the Lapps' right of wandering with their reindeer between the two countries and of making use of land belonging to either had been expressly stated.

The Lapp Question between Norway and Sweden

With the increase of cultivation in the district of Tromsö, where reindeer were customarily pastured at the time when they could do most damage to agriculture, dissension could not be avoided. In 1843 the first Swedish-Norwegian commission was appointed to settle the "Lapp question." This first attempt failed; but it was followed from time to time by others, eventually concluding with the ordinance of June 6, 1883, which remained in force for fifteen years and which has since been renewed on successive occasions. After additional long and comprehensive negotiations, together with careful investigations along financial, scientific, legal, and historical lines, a new Swedish-Norwegian treaty was made on February 5, 1919, regarding the right of the migratory Lapps to reindeer grazing. It is to remain in force from 1923 to 1952. The treaty confirms the right of the Swedish Lapps, especially of the most northern districts, to move their reindeer to grazing grounds in Norwegian territory in the spring as early as May 1. At the same time, however, the grazing grounds in the district of Tromsö have been restricted—all the islands lying outside the coast have been specially excepted; and the number of reindeer that may be moved to the various grazing grounds during the spring and summer has been minutely defined. Swedish reindeer may also be moved into certain tracts in the district of Nordland (Nordlands amt, or *fylke*) during the summer but not into the districts farther south. Regulations in respect to the guarding of the reindeer, the routes by which they may travel, compensation for damage, and other details are also included in the treaty.

The Swedish-Norwegian Lapp question, in itself difficult of solution, has been further complicated by intervention from another quarter, one where the claims of colonizing interests cannot be advanced. During the course of hundreds of years political division of the Lapp country had been effected between Sweden, Norway, and Russia, terminating in 1826 with partition of the territory on the south side of Varanger Fiord between the two last-mentioned states. Certain points of difference remained, however; and, when Norway could not accept the demands made by Russia,[4] Russia in 1852 closed its boundaries, and those of Finland, to the Norwegian Lapps and their reindeer. This action was fraught with disastrous consequences to the Swedish Lapps also. A large body of Norwegian Lapps traveling with reindeer to the reported number of 20,530 but in reality with far more, moved during the years 1853–1871 to the most northerly part of Swedish Lapland where some of them of old had their winter grazing grounds and from whence they could move to their old summer pasturage on the Norwegian coast of the Arctic Ocean, over the wedge of Finland lying between Sweden and Norway. This led to serious congestion, to exhaustion of the grazing grounds, and to other difficulties. When in 1889, this time on the initiative of the Finns, the Finnish boundary was closed to the reindeer of the Swedish Lapps their misfortune was complete.

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[4] In 1851 Russia demanded that the Russian Lapps on the Norwegian frontier should have the right to fish on the Norwegian coast and have a portion of the coast of Varanger Fiord allotted them for settlement. This was considered indicative of a dangerous tendency towards expansion on the part of Russia.

The Treaty of 1919 just mentioned has necessitated the removal of a large number of Lapps from Karesuando, the most northern parish of Sweden, to districts further south where they will no longer need to migrate with their reindeer to Norway during the summer. This is, in reality, an expatriation, because the Lapps that already inhabited these districts speak a language which is almost unintelligible to the northerners and differ from them in other important respects; and, moreover, the peasant population, with whom they must come into contact during the winter, speak Swedish and not Finnish as in their former homeland. The transition period will thus be troublesome both for the newcomers and for their neighbors.

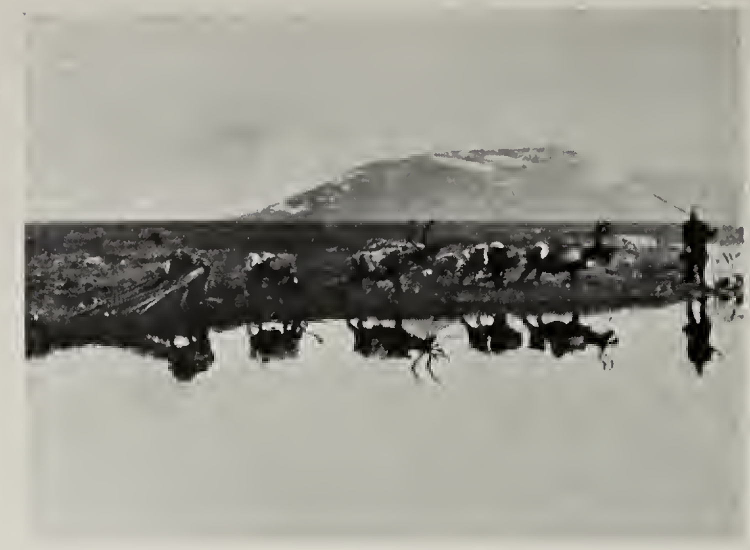

FIG. 3

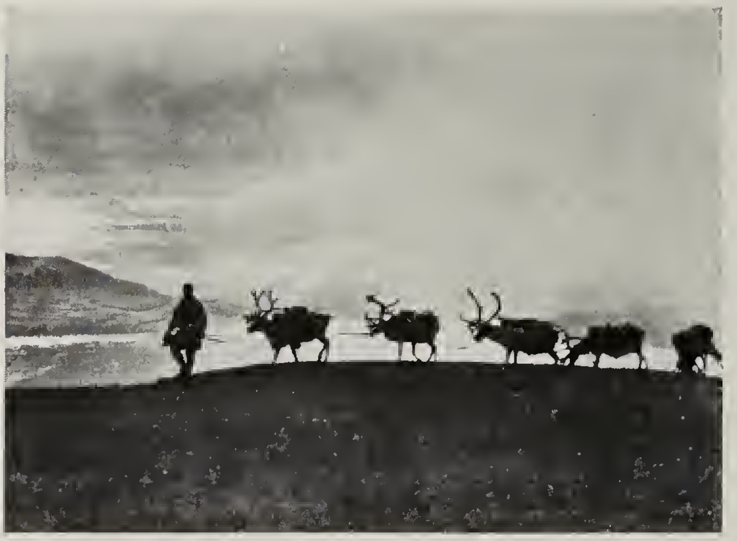

FIG. 4

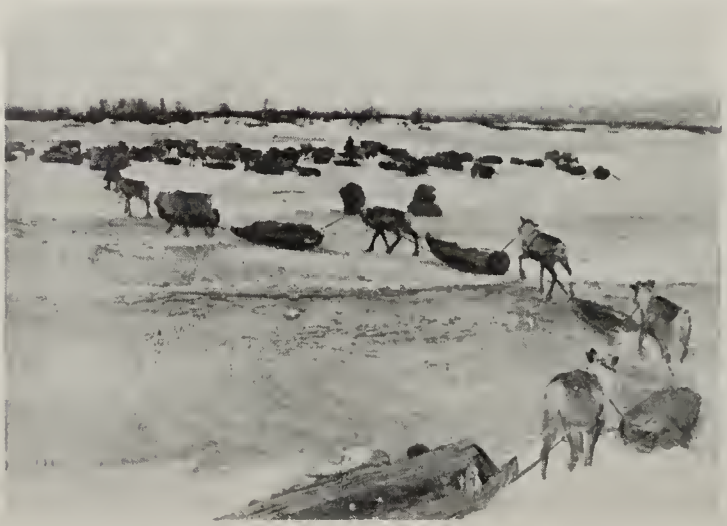

FIG. 5

FIGS. 3–5—Lapp migrations. Figures 3 and 4 show migration in summer. The last reindeer carries the tent poles. Figure 5 shows migration in winter.

The "Lapp Question" in Sweden

Besides these international questions there is that of the internal Swedish Lapp question. The age-old and world-wide quarrel between pastoral nomad and settled agriculturist has been waged here, even in a region of such scattered and insignificant agricultural population as the northern and western parts of Swedish Lapland. The first real law respecting the right of the Swedish Lapps to grazing grounds in Sweden was passed, after lengthy investigations, on June 4, 1886; although long before that, as was natural, several regulations touching these circumstances were in operation. At present a law passed on July 1, 1898, is in force, but further investigations have been going on for a considerable time respecting its revision. This endeavor to reconcile the opposed interests of a specialized primitive culture and those of modern agricultural and industrial development is a matter of concern to the whole nation. In its details the "Lapp question" involves many delicate problems. One of the most difficult, for instance, is that touching the Lapp proletariat, those Lapps who, from one reason or another, have become impoverished and can no longer support themselves as nomads.

An independent farmer cannot exist without a good-sized capital, invested in land, buildings, cattle, and implements; nor can an independent nomad manage without a good-sized capital invested in a reindeer herd and some implements. The farm-laborer question is a hard problem everywhere, and even with the Lapp the servant question has always been a difficult one and in our days is more difficult than ever. In this field also the ideal seems to be "small holdings," i. e. the possession of a herd not greater than the family themselves can manage without outside help. Large herds, depending for the most part or even entirely upon the employment of servant herdsmen, have become more and more difficult to manage, although they still exist to quite a large extent in some districts. Grazing difficulties, disease, and beasts of prey can in a short time decimate and even annihilate a reindeer herd; although, on the other hand, under favorable conditions the herd increases very rapidly. On account of the fairly great risk, therefore, reindeer breeding on borrowed capital only exists to a small extent. In fact this is only a matter to be undertaken by the state, which in this way assists young, diligent, and promising nomads. Heretofore peasants often used to own large reindeer herds, which were managed by hired Lapp herdsmen; but this practice has been forbidden, partly because the Lapps thus came into dangerous dependence on their masters and partly because Swedes and Finns have no right to the historical privileges of the Lapps, in respect of use of the land for reindeer pasturage. Outside the boundaries of Lapland, in the valleys of the Torne and Kalix Rivers, this form of reindeer management is still carried on to a greater or lesser extent.

According to the above-mentioned laws and regulations the Lapps possess the right, during the summer and winter, of using all the mountain and forest lands west of the so-called cultivation line, which during the years 1868–1890 was drawn northeast to southwest across Lapland and west of which no new settlements were to be made. In the tracts east of the cultivation line but within Lapland itself the Lapps may use the lands belonging to the state or those to which they claim a prescriptive right, although the lands may have been granted to private settlers also. Equally during the period from October to April they may sojourn with their reindeer in districts east of the boundary of Lapland and east of the reindeer-pasture mountains in the provinces of Jämtland and Härjedalen which they visit according to ancient custom. Thus their privileges are in reality very extensive.

Relations between the Lapps and the settled population are supervised by four Lapp bailiffs, assisted by several overseers. In other respects the Lapps are under the same administration and jurisdiction as the settled population and have the same duties and rights. During peace times they are, however, exempt from military service, and, as a rule, their taxes are trifling—a circumstance which has not perhaps proved entirely to their advantage.

Number and Distribution of the Swedish Lapps

In the year 1910 Swedish Lapland with an area of 117,984 square kilometers (45,550 square miles), a little larger than Pennsylvania, had a population of 81,535 persons (in 1919, 93,888), of whom only 5738 were Lapps, 6635 Finns (in the most northerly part), and 69,162 Swedes. Of the Lapps 2196 were nomads. Besides this in the same year (1910) in the provinces of Jämtland (37,513 square kilometers, or 14,480 square miles) and Härjedalen (12,849 square kilometers, or 4960 square miles) with a total of 118,115 inhabitants (in 1919, 128,066) altogether, and including a few families in the province of Dalecarlia, there were 904 Lapps, of whom 725 were nomads. In the whole of Sweden in 1910 there was a total of 7138 Lapps. The number of Lapps in the country seems to be fairly stationary. The natural increase appears to be counterbalanced by the number who become nationalized Swedes or Finns or remove to Norway.

Respecting the distribution of the population in the different parts of Lapland, some idea may be formed from the fact that in 1910 in the parishes of this province which lie south of 66° only the easterly ones, which are largely or entirely forested, had a population of from 1.0 to 2.3 persons to the square kilometer (one of them had only 0.8); while the western parishes, where the mountains take up the greater part of the area, and also the parishes lying north of 66° had considerably less than 1.0 person to the square kilometer. The parish of Karesuando, farthest north, had only 0.2 person per square kilometer. Of its 1198 inhabitants, 717 were Lapps, 442 Finns, and 39 Swedes—the last consisting only of officials and their families. It is the only Swedish parish in which the Lapps at the present time are in the majority. The parish of Jokkmokk, the largest, lying just north of 66° and having an area of 19,474 square kilometers (7520 square miles, a little less than New Jersey) had 5416 inhabitants in 1910, of whom 520 were Lapps and 69 Finns. In the two parishes Gellivare and Jukkasjärvi, lying between Jokkmokk and Karesuando, are situated the two large mining communities, Gellivare-Malmberget with 3872 and Kiruna with 5964 inhabitants in 1910 (in 1920, 6542 and 7392 respectively)—a new factor which entirely changes the character of the population statistics. Thus in 1910 the Lapps formed only a very small proportion of the population in the whole of the province of Lapland—7.0 per cent against 84.8 per cent Swedes and 8.2 per cent Finns; in Jämtland and Härjedalen their numbers were exceedingly small—only 0.77 per cent of the whole population; and it is evident that the percentage of the Lapp population will continue to decrease in all these provinces in the future.

The Lapp Dwellings

Where the migrations of the nomadic Lapps range over extensive districts and where they cannot hope always to settle themselves in the same localities, naturally they are unable to use any fixed dwellings but must live in tents both summer and winter. The Lapp tent, which in all districts is essentially the same, consists of a light, removable, and portable frame formed by a number of wooden poles specially made for this purpose upon which is stretched a tent cloth of thick sacking or, in the farthest north, a kind of woven blanket. Nowadays the tent cover is never of reindeer hide or leather. Both the sacking and the woven blankets must be bought, as the Lapps neither have nor could have larger looms than hand ones on which ribbons are woven. The tent is conical with an outlet for smoke at the top about one and a half meters wide; its height is about two meters; its diameter at the base is about four or five meters. On the ground in the middle of the tent is the fire, and over this hangs the kettle. On both sides of the fire the ground is strewn with small twigs, covered by reindeer skins on which the people sit by day and sleep at night. At the back of the fire, as seen from the door, are kept the cooking utensils; the fuel lies between the fire and the door, that is the triangle-shaped opening between two tent poles which is closed by a curtain stretched on cross poles. No table, chairs, or beds are to be seen; only a pair of small chests or some equivalent receptacle. The bedclothes, that is thick rugs of sheepskin or reindeer calfskin (not sleeping sacks) meant for two people, lie during the daytime pushed away under the edges of the tent.

When the weather is clear the tent is pleasant, airy, and light and, when the fire is burning, it is a surprisingly warm dwelling; but when it rains or is foggy the smoke usually stays inside and becomes extremely troublesome. The smoke, the falling reindeer hair, and the white ashes that are blown about in windy weather make it difficult to keep the tent clean at all times. During the night the fire is allowed to die out to prevent sparks flying on to the bedclothes, and one is therefore obliged to sleep fully dressed, especially during the winter. Beside the tent stand the temporary sheds for the preservation of meat, provisions, etc. The Lapp usually has also a solidly built storehouse in some peasant village, where he keeps all kinds of property. Even among the mountains one sees now and then small buildings for the same purpose, placed at the top of single, high, strong post or on a cliff only accessible by a ladder—all this as a means of protection against beasts of prey, particularly wolverines.

In districts where the migrations are not so extensive, and especially in the south, but also in the mountains of South Lapland and by the great lake Tornetrask, one meets with permanent huts instead of the tents; they are of the same construction and of about the same size as the tents but are made of thick stocks and roofed with birch bark covered by turf. They are less airy than the tents but naturally warmer; in unfavorable conditions they can be unhealthy. At the same time in many districts the nomads have begun to take lodgings with the peasants during the winter. This is unfortunate, for they are apt to fall into dependence upon the peasants; and furthermore the reindeer nomad is unaccustomed to the standard of hygiene required in a permanent dwelling.

Nowadays the Forest Lapps usually live in wooden houses of the common north-Swedish type; but they often have also on their lands one or two huts either of the type described above or made entirely of boards with a pyramid-shaped upper part set upon a square base.

Means of Transportation

The reindeer sledge is the most interesting of all the special implements of the Lapps. It has only one runner and looks like a little boat with an abruptly truncated stern. It is drawn by only one animal. There are no shafts but a strong leather trace that passes between the reindeer's legs and ends in a loop or ring of skin round the neck. Latterly in the most northern tracts, a kind of harness, something like that used for horses, has come into use; but even this is connected with the sledge by a single trace and not by shafts. The sledge is usually open but sometimes is closed, when it resembles a coffin and is used as a repository for the more delicate and precious articles. In olden times the Lapp sledge was evidently hand-drawn, developed probably from a hollow log. In some districts two other kinds of sledges are also in use, having two runners, which seem to have developed from the dog sledge formerly used in northeastern Europe.

For purposes of transport in the summer the usual kind of saddle is not used; but two flat, semicircular boards are coupled into each other over the fore part of the reindeer's back and firmly bound together under its belly. The reindeer is not used for riding, excepting occasionally by children. It very seldom becomes so tame that it can be caught by hand, but as a rule a lasso must be used. A halter is afterwards put over its head, connected with a single strong leather rein.

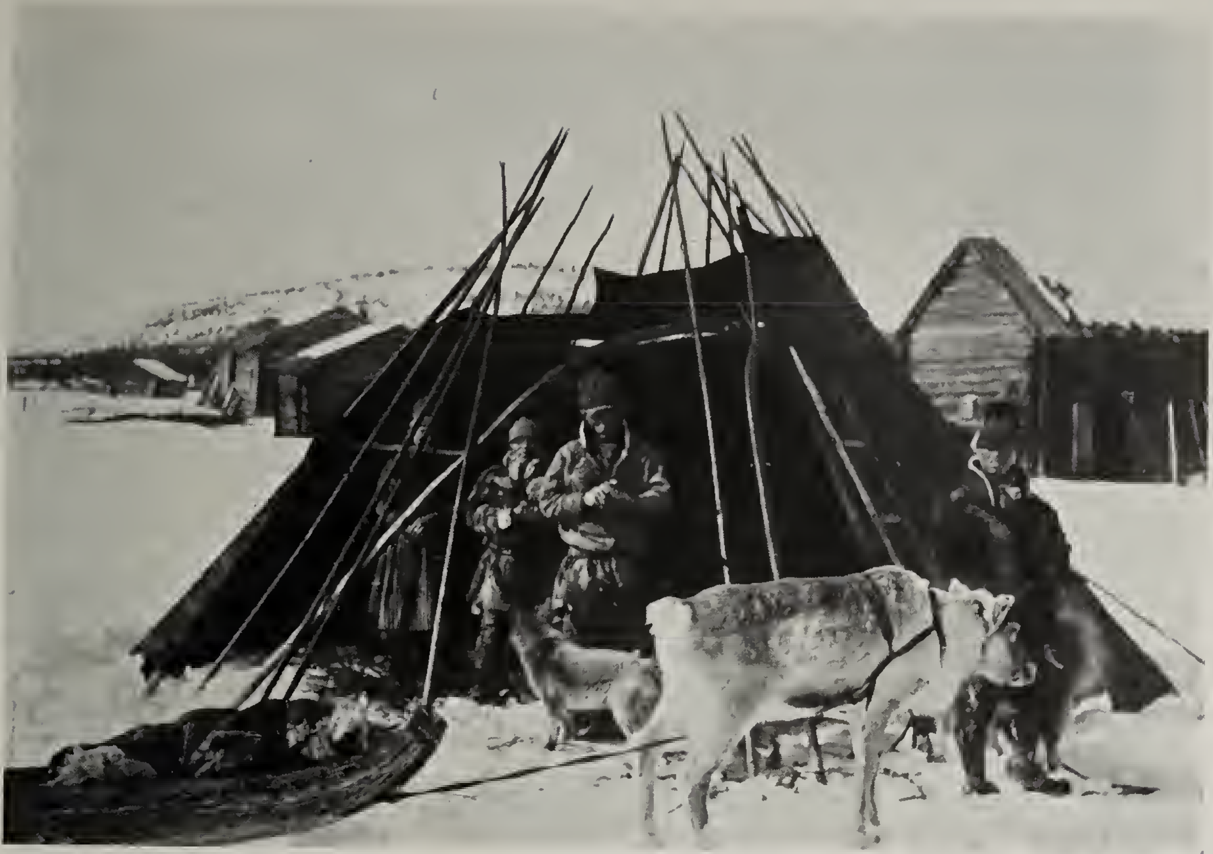

FIG. 6

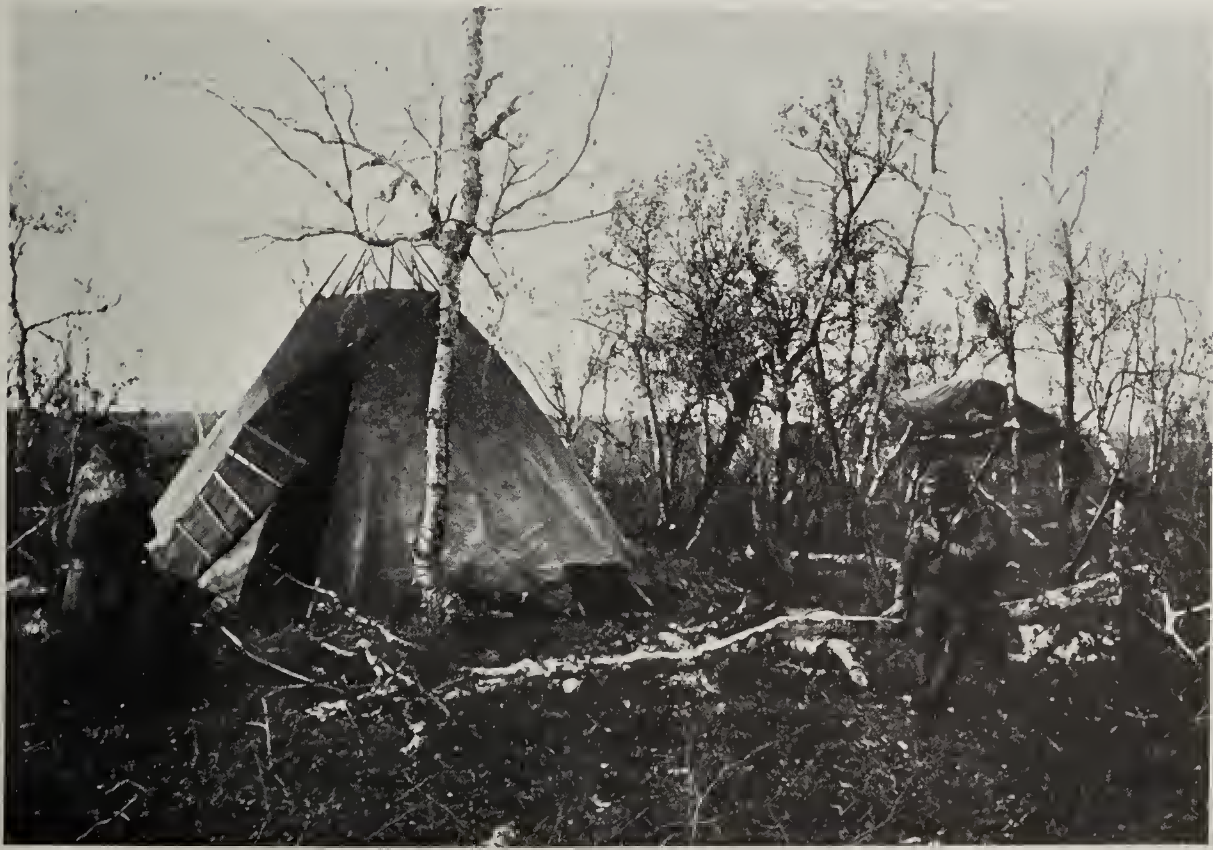

FIG. 7

FIGS. 6–7—The Lapp tent. In Figure 6 part of the cloth is thrown back to show the construction.

Snowshoes are unknown. Instead of them skis are used with utmost dexterity. The skis seem to have been invented in and to have spread from two different centers. In the east, that is in Siberia and North Russia, they were and are covered on the underside with skin, having the hair pointing backwards, both skis being of the same length; the ski runner advances by gliding forward on one at a time, using both alternately. In the west, among the Scandinavians, the left ski was much longer than the right and was not covered with skin; the right ski, however, was covered underneath with skin, and the ski runner advanced by gliding forward on the left one and kicking with the right. With the Lapps and Finns these two types have subsequently been combined into the present form, the long bare skis of equal length which are familiar to us in sport.

Dress

Among the Lapps the clothes of both sexes are almost alike and consist of a cap; an inner tunic or, in winter, a fur coat of reindeer skin with the hair inside; an outer tunic or fur coat with the hair outwards, longer for the women than the men; tight trousers; and shoes similar to moccasins, turned up at the toes and stuffed with hay and joined to the trousers by a tightly drawn bandage twisted several times round the small of the leg. All the furs are sewn together by specially strong thread of reindeer sinews. Tunic and fur coat are confined round the waist by a woven band or, in the farthest north, by a broad leather belt from which hang two knives, giving a rather warlike air to the wearer. The breast is covered by a special, beautifully ornamented garment, hanging from the neck. The high collar of the tunic (found only on the men's garments) and neck opening are generally ornamented with colored cloth. The farther north one goes, the more variegated becomes the dress, banded with broad yellow and red stripes. The material of the tunic is usually dark, black or gray frieze or blue cloth. During the summer leather clothes are also used or worn fur coats.

The cap is different for the two sexes and for old people and children; it varies also according to district, and by it one can tell at a glance where a Lapp comes from originally. In shape it is conical, blue for the men and red or reddish for the women; in certain tracts the men's cap is decorated with a long red tassel, but never the women's; the men's cap in certain districts has a peak. Among the Lapps who have recently immigrated from Norway a man's cap highly variegated and with a square "Polish" crown has appeared in the farthest north. The woman's cap that appeared at the same time has also a peculiar shape, fitting the head closely and trimmed round the cheeks and forehead with broad, projecting lace. The dress of the Lapps taken as a whole is practical and gives a pleasing and picturesque impression. In most districts it is carefully preserved, but in some places the man's cap threatens to disappear and make way for a hat of the usual type. Furthermore, waistcoats and shirts are coming into general use.

The beautiful ornamentation of the dress shows a natural good taste, which is further exhibited in the tools, expecially in the knife shafts, knife sheaths, spoons, buckles, needle cases, pipe cases, knobs for staffs, etc., which are made from horn and adorned by carvings; among these may even be found certain antique Scandinavian patterns. None the less the articles made for selling to tourists are very often rude and ugly.

Food

The food of the Lapps, where it is still of the more primitive kind, consists for the most part of products of the reindeer, that is meat and blood (used in gruel, pancakes, and sausages) together with milk (fresh, frozen, or in the form of cheese but not butter). Reindeer marrow is considered a delicacy, and marrowbones are sent in the course of trade all over northern Sweden. Flour is bought, and nowadays ordinary fermented bread where formerly only home-baked bread, unfermented and made from barley-flour, was used. Potatoes are eaten when they can be obtained, but as a rule the peasants live too far away in the summer and there are no facilities for keeping potatoes during the winter. Special Lapp vegetables are *Angelica archangelica*, *Mulgedium alpinum*, *Rumex acetosa*, and *Oxyria digyna*. Coffee is drunk in large quantities, in the north altogether too much; even tea is used sometimes. Spirituous liquors are rarely met with; no kind of

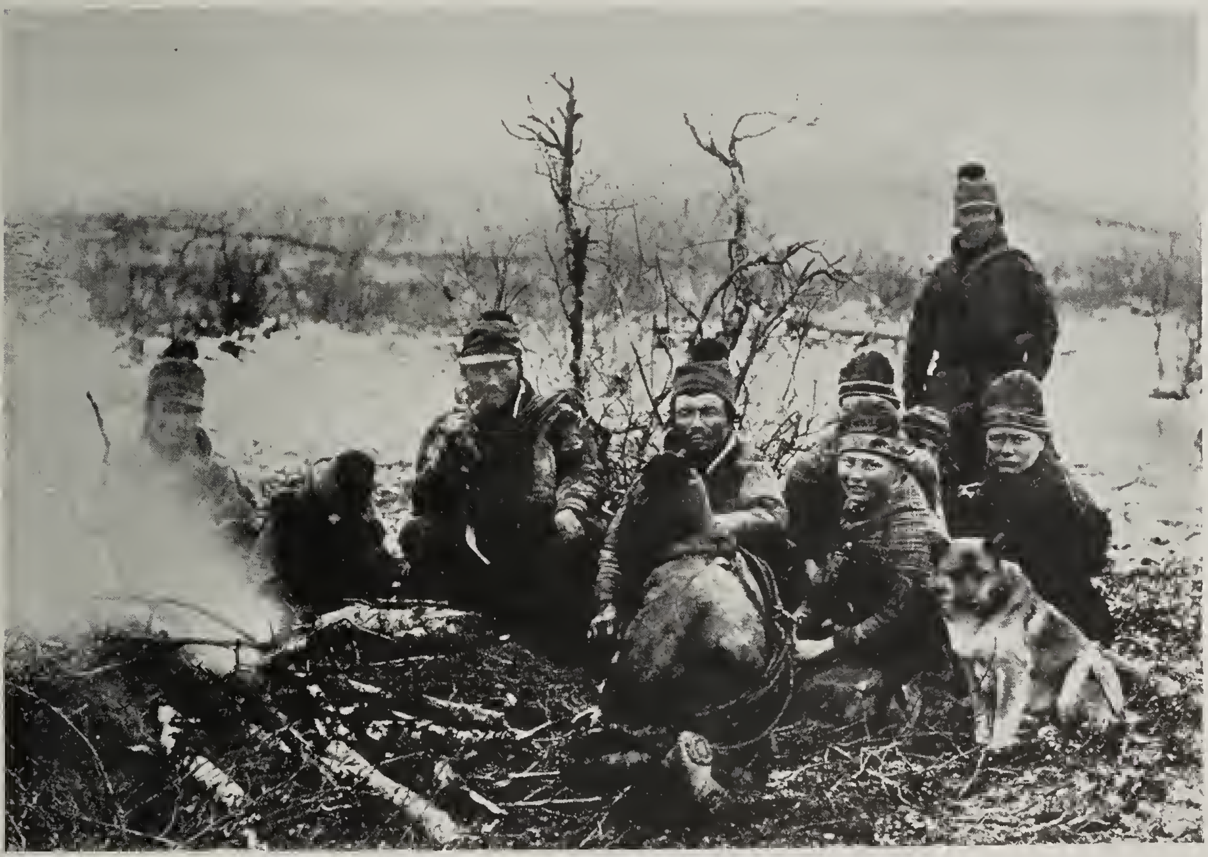

FIG. 8—Lapps round the camp fire; the men have the lasso over the shoulder.

fermented or distilled drinks of their own is known to the Lapps who as regards temperance are now irreproachable as a rule.

Swedish Influence on the Primitive Religion of the Lapps

Some attempt to Christianize the Lapps was made during the Middle Ages; but the first serious effort was not begun until the sixteenth century, when some small churches appear to have been built in their country. Among them was the once renowned but now vanished church at Rounala, up in the mountains on the present boundary between Sweden and Finland, which according to tradition was built by three Lapp brothers at their own expense. During the first years of the seventeenth century more churches were built in the principal localities of Swedish Lapland, which at the same time were organized into the administrative divisions that as a whole have been retained to the present day. The first two Lapp books were printed in 1619, a primer and a little book of religious services; and in 1631 the first school in Lapland was founded at Lycksele. This school, which is still in existence although now an elementary school and removed higher up in the mountains, was intended for the education of Lapp boys as priests to their own people. The work of the seventeenth century was continued with still greater zeal during the following century under the direction of a special "Ecclesiastical Board for Lapland," appointed in 1739.

There is good reason for saying that Lapp paganism, which according to available sources appears to have been a mixture of indigenous Arctic-Shamanistic, ancient Scandinavian, and Christian elements died out completely in Sweden towards the end of the eighteenth century. Only here and there, as in all other nations, is one reminded of it by certain superstitions. Strangely enough such reminiscences appear mostly in the northern part of Lapland where the population, both the Lapps and the Finn settlers, ever since the fourth decade of the nineteenth century have been deeply influenced by the powerful, gloomy, ecstatic religious movement which has been named after its author, the Reverend Lars Levi Laestadius (1800–1861). It has spread over the whole of the territory in Finland, Sweden, and Norway where the Finnish language is spoken and has even been carried to America by Finnish emigrants.

The pagan religion of the Lapps found its most peculiar expression and instrument in the magic drums, i. e. Shaman drums of tambourine shape of the same kind found even today among the primitive tribes in Siberia and northeastern Russia. These drums, which had a skin drawn over one side only and were hung with all kinds of jingling ornaments, were held by means of a handle at the back and were beaten with a single drumstick like a hammer. A number of figures representing gods and spirits, heavenly bodies, houses, beasts of prey, reindeer, etc., were painted on the outside of the parchment; and future occurrences were foretold by the help of a bunch of brass rings, which were laid on the drum skin and at the strokes of the hammer jumped about on the figures. This use of the drum is, however, a secondary one. Originally it was used as an instrument of excitement through the booming of which the Shaman gradually reached a state of ecstasy and at last fell into a trance, during which his soul was believed to fly to distant places or down to the kingdom of death, where it fought the ghosts of the dead for the souls of sick persons. The Lapp drums have disappeared long ago and are now among the greatest rarities of the ethnographical museums. They held their place longest in the most southerly districts, where they were used for fortune telling at a time when in the north even the memory of them had vanished.

The Problem of Lapp Education

As a result of the nomad life led by the Lapps the problem of their education is very difficult of solution, and it has been the object of various experiments during the course of time. Today children first receive instruction from women teachers, often of Lapp birth, who move about with the Lapps and live in their tents. Then follows a somewhat higher education in boarding schools. Great importance is attached to keeping the children's interest in their fathers' mode of life, and books specially prepared for this purpose are coming into use. Swedish is now used everywhere in the schools. Formerly it was Swedish in the south, Lappic in the middle regions, and Finnish farthest north; but the Lapp's knowledge of Swedish is now becoming so general that it can be used for instruction in the schools. The many different Lapp dialects made education in this language difficult, as no form of the native language is common to a large enough group even in the Swedish Lapp districts to be reduced to writing. Furthermore, the use of the Lapp language in religious services is passing out; at present it is only used in a couple of parishes in the central districts; it is replaced by Swedish or, in the farthest north, by Finnish. In the past many priests have come from the Lapps themselves, but at present only one is a university man. The Lapp language, however, shows no signs of disappearing but is preserved carefully in the homes, especially while the Lapps are nomads and very often long afterward. For many years all adult Lapps have been able to read and write.

The Future of Reindeer Breeding and the Nomadic Lapp

It is common experience in Sweden that the children of nomadic Lapps who possess an inherited reindeer herd generally remain nomads. The toilsome and fatiguing nomadic life has its pleasures and advantages too, and those who from childhood have been used to its freedom do not willingly give this up unless the external difficulties become too great. Added to this, during normal years and on the average, reindeer breeding pays exceedingly well. Reindeer meat is easily sold and much liked all over the country; reindeer hides can always be sold, no matter how great the quantity produced; and, lastly, the Lapps are usually good business men who can take care of their own interests. Nomadic life, on the other hand, is checked by advancing agricultural and industrial interests as we have already shown.

The most serious impediment to reindeer breeding and to the continued existence of the Lapps as a distinct national group is to some extent of an internal nature. In southern Lapland the nomadic Lapps, to a very large extent, have procured larger or smaller farms in the mountain districts, where part of the family live all the year round while another part, generally the man and his employees, wander with the reindeer during the winter to a distance of from 200 to 300 kilometers away from home or even farther. During the summer the farm too must be cared for, and this necessarily draws away interest from the reindeer herd and its proper management. It is also doubtful whether the children who have grown up in the cottages of these farms will be willing in the long run to undertake the burden of nomadic life. The matter is, however, of such great importance for the whole of northern Sweden that the state cannot willingly allow reindeer breeding to fail. In the north especially, and even in the south in many quarters, the interest in reindeer breeding which seemed to have declined appears to be reviving again, and it is not impossible that the social movement which began among the Lapps some years ago may also work in the same direction. As an organ for this movement a little journal is edited (in Swedish and Finnish) by a Lapp who has studied law at the University of Upsala.

This matter, however, like all others, will depend in the end upon the personal strength and desire of the people themselves. It cannot be denied that the mercurial Lapps not seldom show some lack of firmness and determination; but, on the other hand, they have succeeded in a characteristic and unique way in maintaining in the heart of a highly civilized community their own peculiarities and their nomadic life. It is to be hoped, then, that the Lapp element will endure. The state could ill spare them, either as producers of meat and hides or as exploiters of enormous districts which are absolutely useless for other purposes. In reality no small sum of money is vested in reindeer breeding in Sweden. In 1911 the number of reindeer in that country was over 275,000, and in 1921 it was about 168,000.[5] According to the above-mentioned Swedish-Norwegian treaty, for the years 1923–1952, 39,000 Swedish reindeer are allowed to graze during the summer in the district of Tromsö and 29,850 in the district of Nordland in conjunction with immigration rights for the Lapps; a number of reindeer—how many is not exactly stated—are likewise allowed to graze during July and August in certain tracts near the frontier inside the last-mentioned district, although the Lapps themselves are not allowed to move in but only to send the necessary herdsmen.

The size of the herds varies of course considerably. Herds consisting of more than 1000 animals are exceptional, but herds of this size are found at present in some districts in fairly large numbers. Such large herds, however, can be managed only with outside help. The largest number of reindeer that can be managed by a moderate-sized family, without the help of strangers, seems to be from 400 to 500, which represents no inconsiderable amount of capital. Several families often combine and manage their herds together—a plan which, given suitable geographical conditions, is of advantage. The herds at certain times of the year must be watched continually both day and night; and this demands great endurance and activity, as the reindeer is an easily-frightened and swift-footed animal. All the adults and all the youth of both sexes must as far as possible take part in this watch, assisted by the well-trained intelligent dogs.

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[5] The number of reindeer fluctuates very much from year to year, and one need not regard the reduction of numbers during the ten years mentioned as anything but an accidental occurrence.

When insufficiently guarded the herd easily disperses, and a reindeer herd run wild soon causes disorder among the neighboring herds also. The reindeer never come inside dwellings; during the summer they are driven into large enclosures for milking or for the separation of strange deer; they are taken home now and then during the winter for examination and the separation of animals for slaughtering purposes; and the herd are then encamped for some hours on a level spot near the dwelling place.

The milking of the reindeer is a troublesome and time-consuming process. It exacts careful management of the herd and unfortunately is beginning to drop out of use. The reindeer cows produce very little, but extremely rich, milk from about midsummer till towards Christmas; the calves are born about the middle of May and during the first months require all the milk the cows can give.

As a beast of burden and for driving purposes the reindeer with its small size and relative weakness cannot be compared with the horse. On the unbeaten tracks among the mountains, however, where the horse can only proceed with difficulty, the reindeer, because of its broad hoofs and light weight, does not easily sink into the snow and is thus a very useful and adaptable animal. The reindeer still plays no small part, therefore, as a means of communication in certain districts; and one can sometimes see, as in Kiruna, such an anachronism as long strings of reindeer with their sledges marching along by the side of an ultramodern electric tramway. The reindeer is an excellent swimmer and can cross fairly broad straits to the isles outside the coast. The wild reindeer has long since completely disappeared from Sweden.

Those who have not themselves seen the life of the Lapps and who do not know the conditions in their country often think it would be doing them a service to persuade them to give up their nomadic life and thereby "improve their culture." These persons overlook the fact that culture takes many forms and that the point which a civilization has reached depends in great measure upon geographical conditions over which mankind has little control. A peasant or mechanic does not necessarily stand higher as regards culture than a sailor, although the last follows a "nomadic" life of a considerably more intensive kind than does a reindeer-breeding Lapp. A nomadic Lapp need not theoretically stand lower as regards culture than does a peasant living *in the same tract.* In fact one often sees the opposite: the nomad goes out into the world and sees more than the peasant does; he gains greater experience, more knowledge, better manners than does the settler bound to the soil in the mountain districts. Generally speaking, however, we can say that the Lapp's position in regard to culture is much the same as that of the peasants with whom he most often and most closely comes into contact, that he is as well-informed as they are, about as tidy or untidy as they are, and holds about the same views of life as they do. That the finest flowers of culture cannot open or thrive in a Lapp tent is obvious; but it is just as impossible in the neighboring farmhouse. But no one for the sake of culture attempts to decoy the inhabitants of these farmhouses away from the wastes they live in to an uncertain fate in the big towns.

It should not take even the chance visitor to their territory long to discover that the Lapps are by no means "savages" and that it would be both unmerciful and foolish to lure them away from a mode of life whose value both to themselves and to the community at large casual observation gives no means of estimating.

THE PORT OF STRASBOURG

By J. Levainville

The fortunes of Strasbourg arose from its position at a crossroads which by land and water put the town in touch with countries of rich and varied resources.[1] On the immediate outskirts of the city is the Rhine affording a means of communication between the Alps and the lowlands bordering the North Sea; the Kinzig drains the plain of Baden and the Black Forest and leads to the Danube; the Ill, traversing Alsace, opens ways into Switzerland and, by the gap of Belfort, into Franche-Comté and Provence and to the Mediterranean coasts. Finally, in the west is the old Roman road crossing the Vosges by the Col de Saverne to pass thence through Lorraine and Champagne to the Ile de France. In good time on the banks of the watercourses or along the borders of the roads which passed through this nodal point, quays and warehouses were built and the port came into being. The monopoly of transportation was in the hands of the powerful guild of boatmen, who were known to their contemporaries as "promoteurs et inventeurs" of navigation on the upper Rhine. Together with wholesale merchants and boat builders of the town they formed the famous corporation of the Ancre which met at the tavern "zum Ancker" and there held a sort of freight exchange whose function may be compared to the present-day meetings of Lloyds. The majority of its adherents lived in the southeastern quarter of the town, in the Krutenau, and they had a preponderant voice in the city council.

The prosperity of the port suffered frequent interruption through the wars that time and again devastated the regions tributary to the port—the revolt of the Netherlands, the Thirty-Years war, the Dutch war, the campaigns of the Revolution and the Empire. But later more serious effects were sustained from economic causes, such as the competition of Kehl. In particular the beginning of the railway era marked a period of decline. Merchandise from Basel to London was sent by rail instead of by the more expensive Rhine route. Decline was for a time arrested by the opening of canals giving access to the port—that of the Rhone-Rhine in 1841, the Marne-Rhine in 1853. This measure had for its result a change in the function of the port. Traffic on the river, almost completely abandoned by the big barges, was restricted to lumber rafts and fishing boats, and to vessels carrying sand and gravel. On the other hand, anchored at the quays of the port might be seen numerous pinnaces loaded with coal from the Saar and

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[1] See especially Lucien Gallois: Le port de Strasbourg, *Ann. de Géogr.*, Vol. 28, 1919, pp. 414–424; Gaston Haelling: Le Rhin politique; économique, commercial, Paris, 1921; G. Arnaud: Le port de Strasbourg, Paris, 1921. M. Baulig, professor of geography at the University of Strasbourg, has photographed especially for this article certain aspects of the port, for which grateful acknowledgment is here made.

Belgium, grain from Alsace, the north of France, and Flanders, building materials from the Vosges, wines from Alsace and France.

The war of 1870 and the Treaty of Frankfurt closed to the port its western outlets. In 1889 traffic was barely 162,000 tons, a miserable figure compared with that of other Rhine ports; Duisburg-Ruhrort, 5,312,000 tons; Mannheim-Ludwigshafen, 3,299,000 tons. The attention of the Alsatian port was specifically directed towards the Rhine; but here traffic was susceptible of development only if the river were regulated to permit the access of large barges at all seasons of the year. As it was, the larger craft could only reach the port during the seasons of high water, some 150 to 200 days a year; most often they were compelled to lighten their cargo or to stop altogether at Mannheim.

It was the great port of Baden that offered the most strenuous opposition to the improvements projected by Strasbourg. Mannheim was unwilling to lose its dominant control of transit trade on the Rhine for goods from Belgium, Holland, and Westphalia destined for Bavaria and Switzerland. It took 30 years of persistent effort to overcome this bitter opposition. In fact, though the arrival at Strasbourg of the Rhenish steamer *Industrie 24* on June 16, 1892, may be said to have marked the resumption of navigation on the upper Rhine, development of a really intensive traffic only dates from 1913 with completion of the work (in hand since 1907) providing a minimum depth of 1.90 meters in the fairway. The port itself has been transformed by parallel improvements until it compares favorably with its powerful rivals on the Rhine. It is a thoroughly up-to-date economic organism that has been returned to France by the Treaty of Versailles.

Access to the Port

The Rhine

In spite of numerous tributaries descending from the Vosges and the Black Forest, the Rhine from Basle to Strasbourg is characterized by a torrential regimen betraying its Alpine origin. Seasonal variations—summer floods and winter low water—are the more pronounced and rapid as the gradient is steep from Basle to Strasbourg. It is 1 in 1000 to Brisach; 0.6 at Kehl and as far as Rastatt, whence it decreases to 0.19 at Mannheim. A barge which carries a full cargo to Strasbourg in summer must discharge half en route in winter. Rhine navigators invariably allow a margin of 30 centimeters between boat keel and river bed to guard against sudden fall in the waters which may be very rapid in case of drought.

Depths of the channel in different sections of the river are these: from Strasbourg to Mannheim, in summer 2.8 meters, in winter 1.7 to 2.1 meters; from Mannheim to Bingen, in summer 2.8 meters and more, in winter 2.3 meters; Binger Loch, from 2 to 2.9 meters; from St. Goar to Cologne, 2.9 meters except during three months of summer when it varies from this figure to 2.49 meters; from Cologne to the sea, between 3 and 3.9 meters at all seasons. The river may thus be divided into three different stages through which passes merchandise loaded at Rotterdam or Antwerp for Strasbourg: to Cologne on the maritime Rhine; from Cologne to Mannheim on the lower Rhine; from Mannheim to Strasbourg on the upper Rhine.

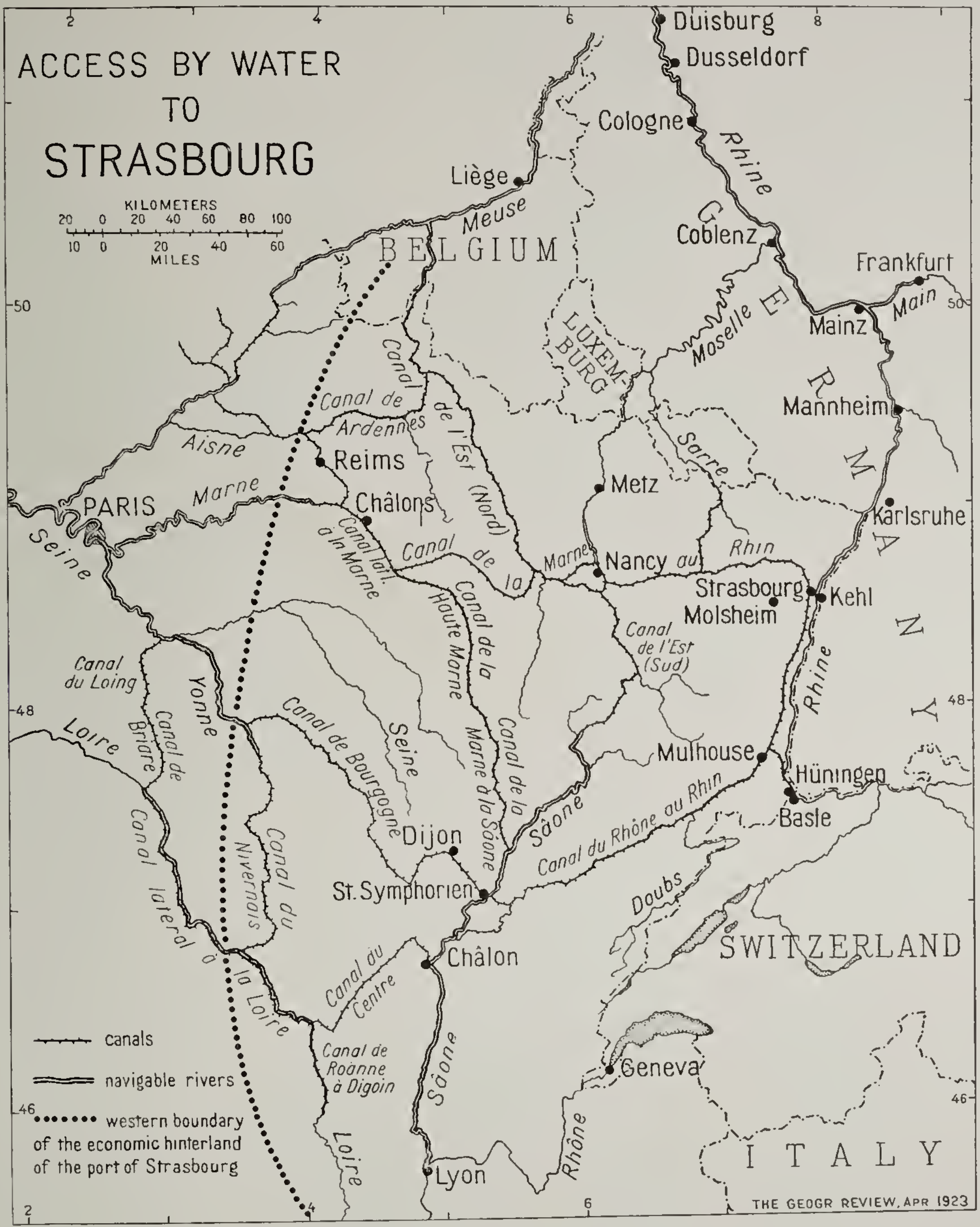

Fig. 1—Sketch map showing the means of access by water to the port of Strasbourg. Scale approximately 1:5,250,000.

In each of these sections merchandise makes use of different equipment and facilities for transportation. The port of Strasbourg by reason of its situation and the geographical conditions of the Rhine is in strict dependence on Antwerp and Rotterdam, its points of contact with the sea; on Cologne and Duisburg, transshipping points for the large barges and highpowered tugs; and on Rheinau and Mannheim where are warehouses to receive the un-loaded surplus and basins where are made up the trains of barges or freight cars for the last stage of the journey.

THE CANALS

Strasbourg, which at the beginning of its history under the Roman conquest was a town of land routes, became during the French period a town of canal routes. Twice it was the canals constructed by French engineers that saved from decay the port abandoned by Rhine navigation.

The first canal, that of Bruche, 20 kilometers long, was cut in 1682 after the plans of Vauban and was designed to transport stone and other material from Molsheim for building purposes and fortifications. Completion of the Rhone-Rhine canal, begun under Louis XV, was retarded through political events; and the canal was only opened to navigation under Louis Philippe. It commences at St. Symphorien on the Saône, follows the Doubs, crosses the watershed at Valdieu, and traverses Alsace between the Ill and the Rhine. At Mulhouse the Hüningen canal branches off to the Swiss frontier. The Marne-Rhine canal, begun in 1827, was opened to navigation between Nancy and Strasbourg in 1853. It crosses the Vosges by a tunnel at Artzwiller. Two branches serve Lorraine, the Saar canal (canal des houillères) and the canalized Moselle.

The network of waterways centering about Strasbourg would have formed a homogeneous whole had its unity not been broken by the Treaty of Frankfurt. The Freycinet laws (1879) called for a depth of two meters on the French canals, the depth required by the Flemish pinnaces of 280 tons. But this transformation did not affect the Alsatian sections, whence a troublesome transshipment was imposed on freight. A German law of 1892 called for the same depth on the canals of that country. The measure was carried into effect on the Saar and the Marne-Rhine canals but not on the others. The Rhone-Rhine canal terminated in a cul-de-sac at Mulhouse, that of Hüningen at Kembs; the Moselle was only canalized as far as Metz. Strasbourg found itself deprived of relations with important industrial and commercial regions: to the northeast the mines and metallurgical works of Lorraine and Luxemburg; to the south the Swiss plains, great importers of coal and grain. To break these barriers against its growth Strasbourg exhibited the same energy that had been displayed in regulating the Rhine. Before the war the Hüningen canal had been increased to a 225-ton capacity; but improvement of the port depended on arrangements with Switzerland. Negotiations to this end, which were interrupted during the war, have since been renewed.

The most tangible result has been obtained in the last few years on the Rhone-Rhine canal. On May 27, 1919, M. Millerand, commissioner general of the French Republic at Strasbourg, ordered the commencement of works on the Alsatian canals to accommodate the 280-ton pinnaces. In spite of the handicaps existing at the time, the enterprise was carried forward with great rapidity. Today navigation is as easy on the Rhone-Rhine canal to Lyons as it is to Nancy on the Marne-Rhine canal. It is a convincing example of French energy in reconstruction after the war.

The Railroads

The line from Strasbourg to Basel was opened in 1844, Strasbourg to Paris in 1852, Mulhouse to Belfort in 1858, Strasbourg to Kehl in 1861. These years marked a period of decline for the port, for the Rhine navigation was almost annihilated. Today rail and water traffic are closely co-ordinated to mutual advantage. As shown in Table I, the major part of the importations are carried by water, of exportations by rail.

Table I—Trade of the Port of Strasbourg (1913)

Routes	Importations		Exportations	
	Tonnage metric tons	Per cent	Tonnage metric tons	Per cent
Rhine	1,655,000	70	340,000	22
Marne-Rhine canal	190,000	8	160,000	2.5
Rhone-Rhine canal	78,000	3	265,000	16
Bruche canal	54,000	2	1,900	0.1
Railroads	413,000	10	979,000	58

The line from Strasbourg to Kehl is the great collector of traffic. On the right bank it serves the Rhine provinces, Prussia, Bavaria, Switzerland. On the left bank it commands the ways to the northwest to the Palatinate, to the north by the Sarrebourg line towards the Saar, Belgium, Luxemburg, and Lorraine; to the west to the Vosges; to the south to Upper Alsace, Switzerland, Burgundy, and Provence. The dual focus of routes Strasbourg-Kehl is a medium of world traffic, a circumstance which explains the rivalry between the two railroad stations, each of which seeks for itself the benefit of the transit trade. Up to 1914 the railways of Baden and Alsace were engaged in a tariff war. The German Empire was long opposed to development of the system on the left bank of the Rhine. But here again Strasbourg exhibited its characteristic qualities of initiative and energy and eventually secured an accord by which it enjoyed equal tariff with Kehl on freight in transit to Switzerland. This tariff, however, was only applicable for the Alsatian station on water-borne goods.

Traffic of the Port

Paralleling the improvement in ways of access were the port works undertaken by the Strasbourg Chamber of Commerce. It would take too long to recount here the struggles against the military engineers of the German army and the various discriminations against the new port, but in the end the Strasbourgers gained an economic victory. The port as rendered to France by the Treaty of Versailles includes three series of basins situated to the south of the town between the Ill and the Rhine at the confluence with the Little Rhine, the last constructed in contact with the river. The total area of the basins is 44.86 hectares, of the port 200 hectares; and there are 10,710 meters of water front.

The business of the port is almost entirely a transit trade in bulk goods. Of the total of goods entering the port (upstream and downstream) 88 per cent was accounted for by the following items: fuel (934,000 tons), grain (516,000 tons), petroleum (24,000 tons). Of goods leaving the port 76 per cent was accounted for by iron goods and machinery (102,000 tons), potash salts (71,000 tons), lumber (42,000 tons), and salt (35,000 tons). Before the war coal formed the principal commodity handled by the port. Strasbourg is splendidly situated as a coal *entrepôt.* Coming by way of the Rhine, coal from England, the Ruhr, and the Aix-la-Chapelle region is discharged on the quays beside coal from Belgium and the Saar which furnishes an important freight on the Marne-Rhine canal and the railroads. The chief customers for Strasbourg coal were Switzerland (323,000 tons), Upper Alsace (244,000 tons), eastern France (123,000 tons), Baden and southern Germany (30,000 tons), and southern France (10,000 tons).

The harbor installations of the Westphalian and Rhenish coal companies, covering 40 hectares, are the finest in the port. The total facilities of the port permit of a coal transshipment of about 500 tons per hour; the dockyards can carry a stock of 500,000 tons. The briquette factory of Hugo Stinnes on the Austerlitz harbor could deliver 65 tons a day.

Since the armistice the German concerns have been transferred from Strasbourg to Kehl. Their installations have been sequestrated, and French business men of the commercial hinterland of Strasbourg, Nancy, and Grenoble have been in charge of the commercial function of the port.

The grain trade also contributes a characteristic feature to the port. The six-storied warehouses, electric cranes, and elevators dominate the quays. In sum the warehouses afford 64,150 square meters of utilizable surface and can stock 13,600 tons. This equipment is divided between the two great milling establishments on the Commerce basin: the Société des Moulins Illkirch and the Société des Moulins d'Alsace. They have a grinding capacity of 5500 sacks and 1600 sacks per day respectively, and their grain silos storage capacities are of 150,000 tons and 30,000 tons.

Before the war, grain came chiefly by way of the Rhine from Russia and America (502,000 tons in 1913). It was distributed to Switzerland, Alsace. Lorraine, and in small amounts to the neighboring frontier regions of France. In this respect the rôle of the port of Strasbourg was almost entirely regional.

Of the other products entering into the port trade and representing 36 per cent of the total tonnage, petroleum, potash, and iron ore may be given separate mention.

The petroleum industry has assumed a great importance with the conclusion of peace. The Alsatian mines of Pechelbronn have replaced a German concern. Three French companies have constructed tanks and opened storage depots, awaiting the completion of the new petroleum dock which is one of the projects of port extension.

It appears also that Strasbourg will become the great port for the shipment of the Mulhouse potash. Extraction, limited to 350,000 tons in 1913, exceeded 600,000 tons in 1919 and will attain 2,300,000 tons in 1922. Of this total 1,000,000 tons will be sent by the Rhine to Belgium and oversea countries.

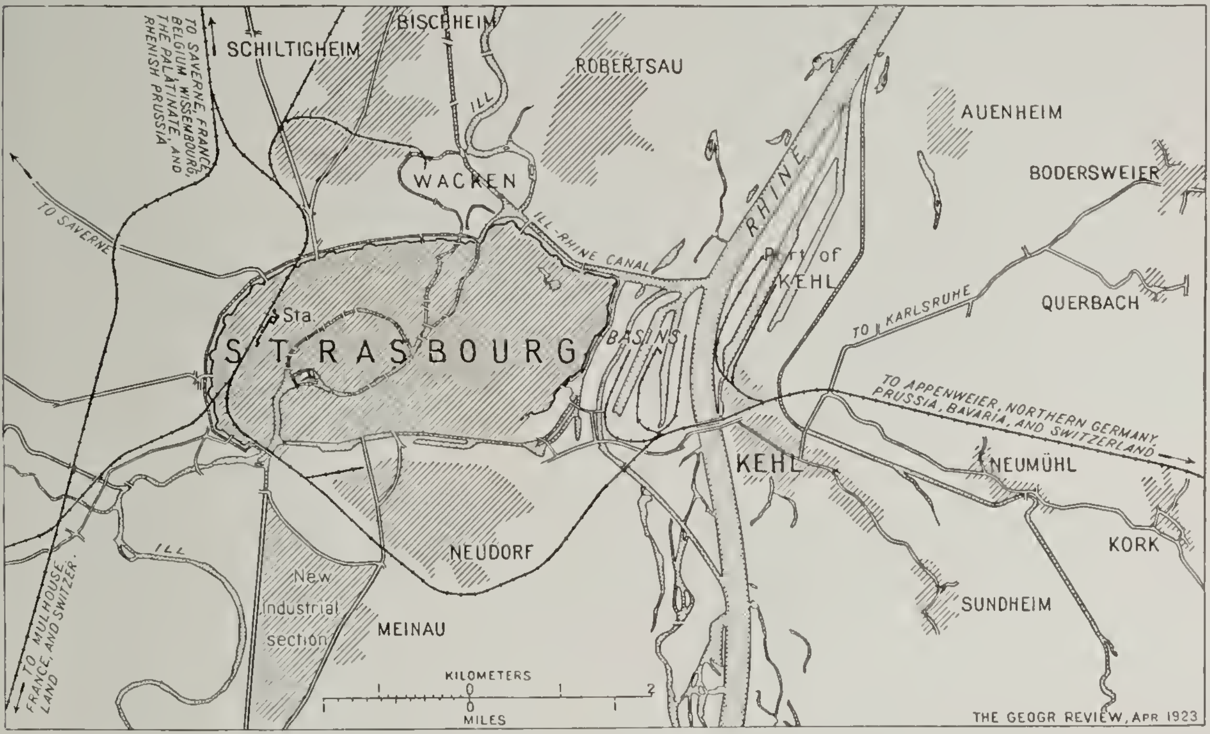

FIG. 2—Sketch map showing the immediate vicinity of the port of Strasbourg. Scale approximately 1:115,000.

The future also appears good for transit trade in iron ore. In 1914 some use was made of the waterways to send ore from Lorraine to Westphalia, and during the war congestion on the railroads obliged almost complete dependence on the Rhine. The continuance of this traffic appears to be bound up with the importation of coke for metallurgical purposes. The friability of coke makes it ill adapted for frequent transshipment. To obviate this inconvenience several big German firms situated in the industrial section of the port had bought the necessary equipment for the construction of coke ovens. Thus coke manufactured here can be carried by rail from Strasbourg to Lorraine, and ore can be sent as a return freight whence it will go down the Rhine to Ruhrort.

The Future of the Port

Petroleum, potash, and iron ore are local products within the sphere of Strasbourg's commerce. But it would seem that the port may legitimately

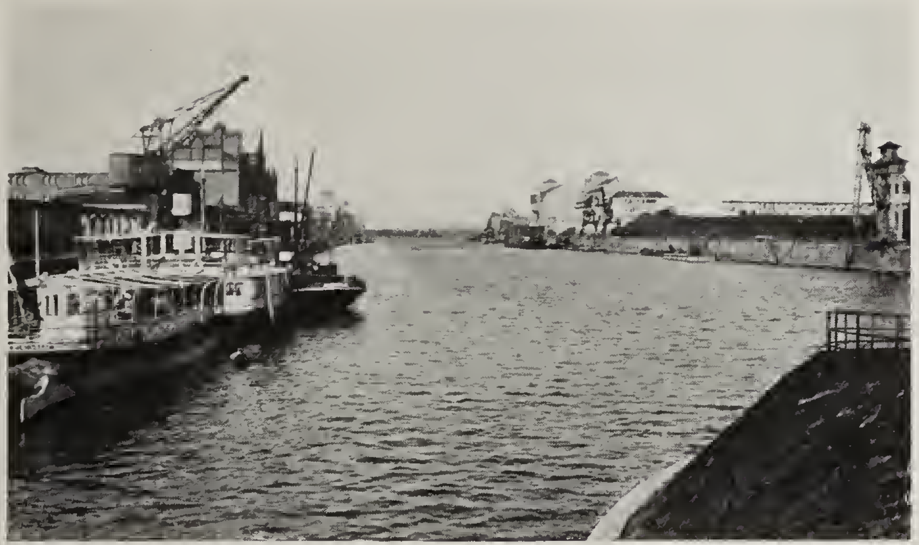

Fig. 3

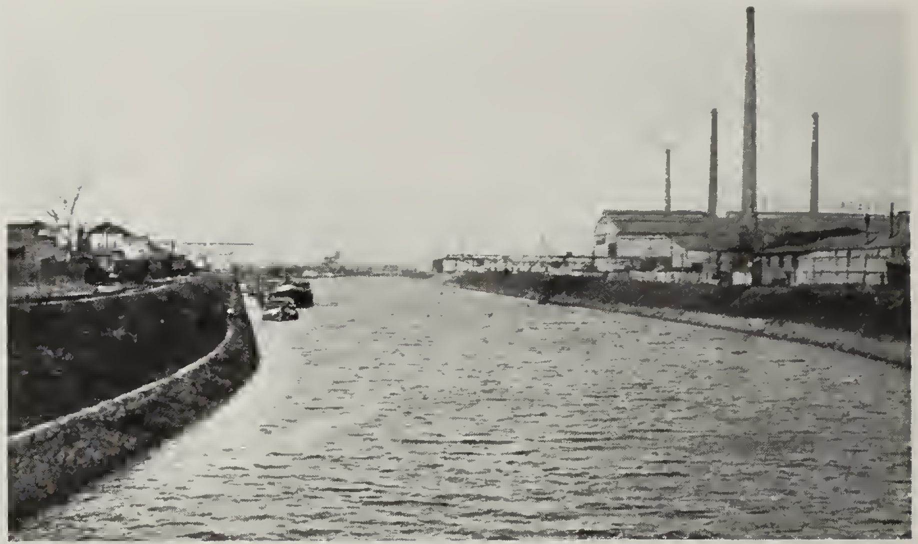

Fig. 4

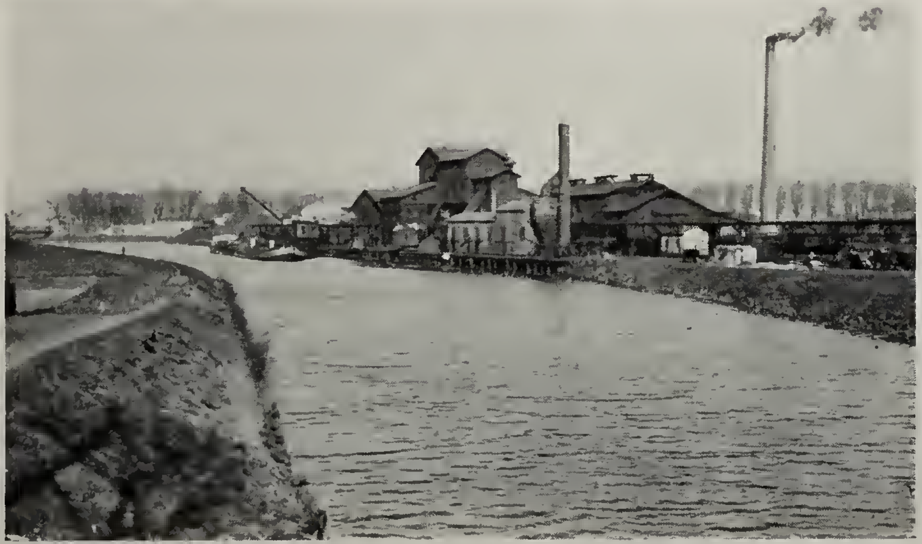

Fig. 5

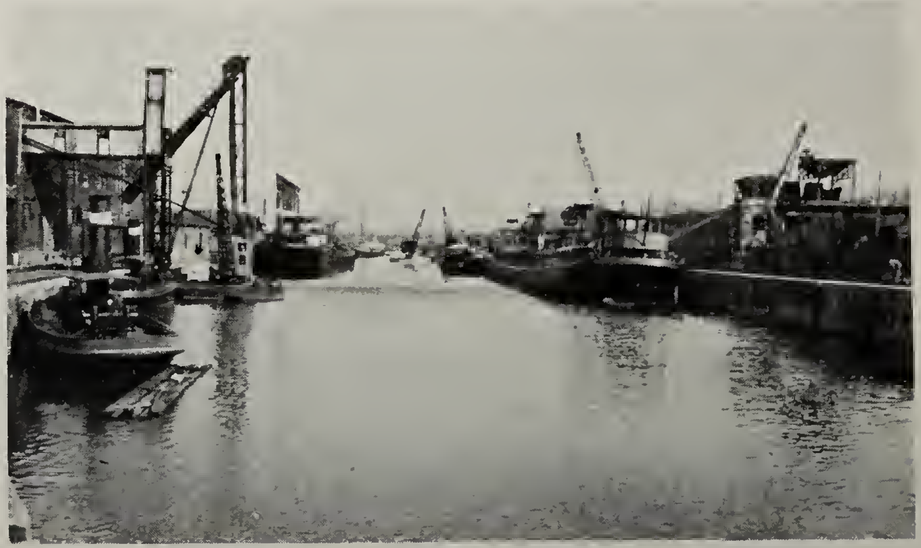

Fig. 6

Figs. 3-6—The port of Strasbourg. 3, Basin of Commerce, looking towards the mouth: on the left, municipal warehouses; to the right, grain elevators; and in the distance, cranes for discharging coal. 4, Basin of Industry, looking towards the mouth: to the right, iron works of Strasbourg; to the left, wood yards. 5, the claim to serve other French provinces than Alsace and Lorraine. Released from the handicaps of German control, the port furthermore acquires a greatly enlarged economic hinterland. Henceforth fifteen French *départements* at the greatest distance from the coast will possess an outlet to the sea. One can say with truth that Strasbourg is the maritime port of eastern France.

According to the port management of Strasbourg and Kehl the annual requirements of this new economic hinterland are: coal, 2,000,000 tons; grain, 300,000; oil seeds, 110,000; phosphates, 50,000; wood pulp, 100,000; other articles—colonial products, cotton, wines, etc.—700,000. If to this is added the 1,500,000 tons which Strasbourg already distributed to Alsace and Switzerland before the war and a prospective increase for the mining industries, the trade of the port in the near future may without undue optimism be estimated at 7,000,000 tons. Trade in 1920 (1,820,000 tons) closely approached that of 1913. In fact without temerity a future trade of 10,000,000 tons may be forecast, though to realize this dream extensive improvements will have to be carried out in the port itself.

A French Fleet on the Rhine

The first difficulty has already been solved. Before the war the trade on the Rhine was practically entirely in the hands of Westphalian industrials and of the German state. The non-German flag was represented on only 13 per cent of the tonnage reaching Mannheim and 8 per cent of that reaching Strasbourg. On the signing of the armistice many French companies were formed for navigation on the river. They ran up against a stumbling block in the attitude of the German towing companies. The actual transportation remained as before the war in the hands of the Germans, some Dutch companies being excepted. Freight charges began to show the effect. As at the beginning of the railroad era, water-borne merchandise discharged at Rotterdam paid a higher rate than that carried by rail. Since traffic on the Rhine calls for specialized forms of transport and dock facilities, the cheapening of river transport could be brought about only if France were given a balanced award of facilities of every kind. Provision for this was made in the Treaty of Versailles (Articles 339 and 357), and it has been carried out according to the decision of the American arbitrator, Mr. Walker D. Hines. He allocated France 13½ per cent of the German Rhine fleet—254,150 tons of barges and tugs of a total of 23,760 horse power—to be ceded immediately; a supplementary cession to be made if the limiting value of reparations from the river fleet (20 per cent as constituted at the time of the armistice) fixed in the general reparations clauses (Part VIII, Annex III) had not been reached. It was prescribed that the barges should include all classes of tonnage in proportion to that of the vessels entering the port of Strasbourg in 1913, excepting barges of less than 500 tons. The tugs were divided between screw tugs of 2566 total horse power for navigating the section between Duisburg and Rotterdam and side-wheelers of 21,194 total horse power for the section from Duisburg to Strasbourg.

Similarly for the docking facilities of the Rhine fleet. The decision of the arbitrator gave France the following advantages: entire ownership of a shipyard for coal transfer at Rheingau; at Mannheim a building and equipment for grain storage; at Ludwigshafen, Cologne, Duisburg-Ruhrort, and Rotterdam, use for 25 years of installations for storage or transit of considerable tonnage. Thanks to these facilities placed at its disposition, French navigation on the Rhine finds itself better equipped than any of the great German concerns: it equals in importance that of the great combine, the Kohlenkontor.

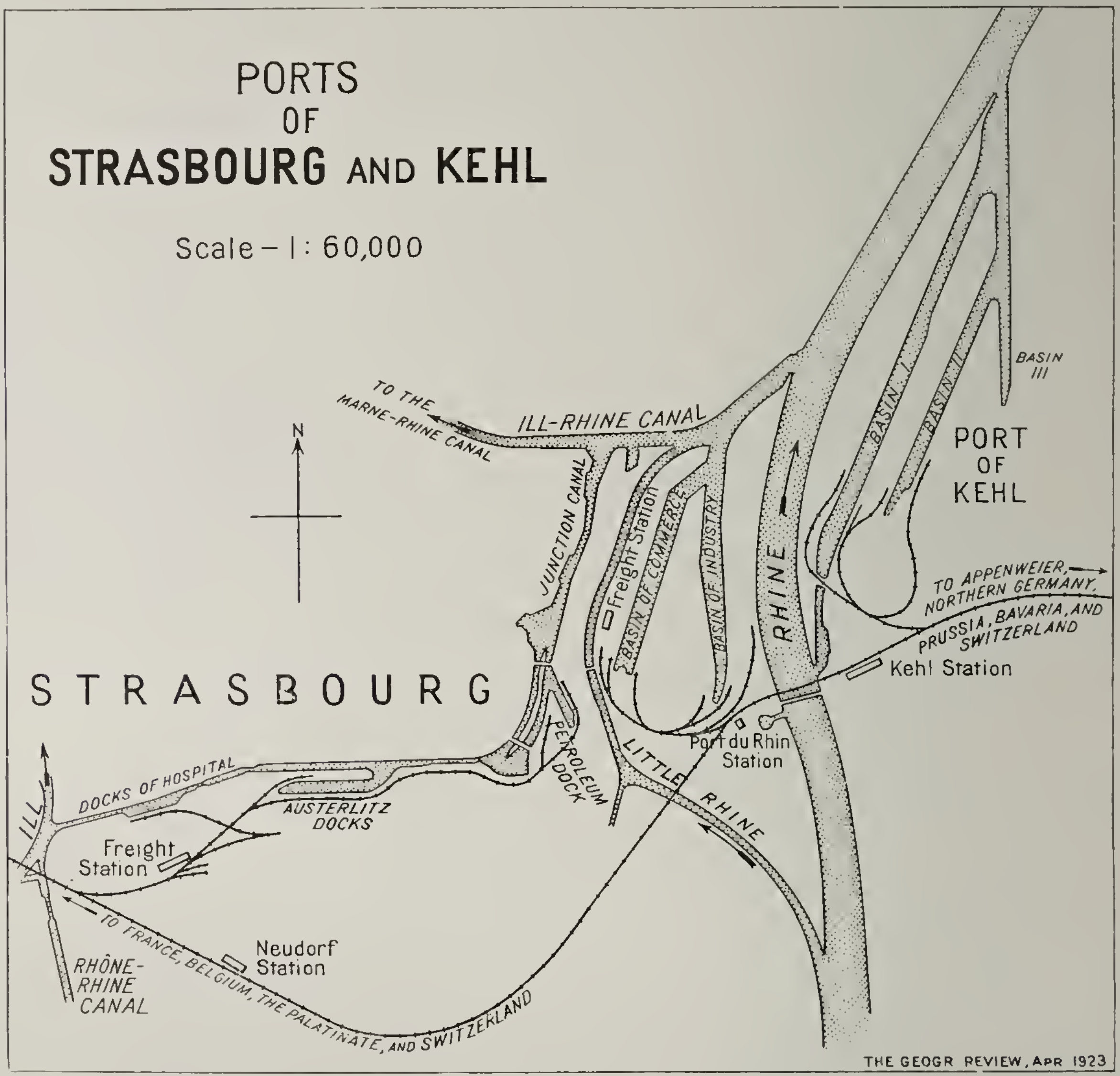

Fig. 7—The ports of Strasbourg and Kehl. After G. Haelling, "Le Rhin," map facing p. 171. According to Article 65 of the Treaty of Versailles the ports of Strasbourg and Kehl were to constitute for a period of seven years a single unit from the point of view of exploitation.

Improvement of Means of Access

The problems concerning the ways of access are less easily solved. Besides the difficulties of connection between the different parts of the fluvial system which have been described above, even in the improved sections traffic suffers from the taxes levied to pay off the cost of the works, from delays at the locks and waiting for cargoes in ports where discrimination existed in favor of the railroad, and from stoppages due to ice, low water, and the necessity of going into dry dock. These stoppages amounted on the average to 47 days a year on the Saar canal in the years 1897–1904; 63 and 62 respectively on the Marne and Rhone canals. On December 2, 1919, the French government promulgated a law for industrializing the Marne-Rhine canal system. The law provides for the maintenance of a reasonable amount of water from reservoirs built along the course and a diminution of delay by doubling the locks and broadening the narrow passages in the section from Vitry le François to Strasbourg and on the Saar canal. It is understood that the new locks will accommodate boats of 600 tons. It is with this 600-ton capacity in view that studies will be made for the canalization of the Moselle between Metz and Thionville, of the Orne, and of the Fentsch to assure a regular ore transport to Strasbourg.

Finally the Treaty of Versailles gives France the right to construct on her own territory from Strasbourg to Basle a canal paralleling the Rhine and to utilize the hydraulic energy to be derived from the fall of 100 meters obtaining between the two towns. This canal, which will be a waterway of the first order, will connect Strasbourg with the industrial sections of Mulhouse and Basle and, prolonged by a new canal of the necessary capacity for 600-ton boats, will assure connection with southern France.

The attention of the French administration has been equally directed towards the railways. Besides a doubling of tracks on the Paris-Metz line between Lérouville and Metz and on the Paris-Strasbourg line between Pont Saint Vincent and Blainville, which has for long been recognized as an indispensable step, the question of railways crossing the Vosges has been considered. At present this barrier is crossed only at the two extremities—by the pass of Saverne and the threshold of Valdieu. The cotton centers of Épinal and the cut-glass works of Baccarat are without direct communication with the Alsatian port. Plans for two lines—Saales-Saint Dié and Wesserling-Bussang—have been accepted, and work on them has already commenced; two others have been proposed which would effect a more central crossing—Sainte Marie aux Chênes-Saint Dié and Metzeral-Cornimont.

When these improvements of access are carried into effect Strasbourg will be able to command a trade of the tonnage we have stated. But its accomplishment will be dependent on enlargement of the port and its facilities.

The Port

At present with the improvements under way the port can accommodate an annual traffic of 4,000,000 tons. A plan has been projected which will permit of an enlargement to 10,000,000 tons. This plan comprehends two ports with free entrance on the Rhine: one the old harbor with the basins of Commerce and Industry, the other a new one to be constructed above the bridges joining Strasbourg and Kehl. The two harbors will be united by a canal with locks, the central part of which will itself constitute a very large basin; in addition are the docks of Austerlitz and a special petroleum dock under construction to the north of the present harbor.

Finally, with development of the maritime trade in view, Antwerp has been declared the outport of Strasbourg, and arrangements have been made accordingly. A surtax on bonded merchandise would mean the death of the Alsatian port, and all merchandise passing through the Belgian port is now exempt from dues. Furthermore, establishment of the Commercial Exchange will permit of regular direct transactions from over seas to Strasbourg.

Conclusion

These changes and innovations demand considerable amounts of capital, but they will be productive investments. In 1913 the trade of the port reached 2,700,000 tons. According to our port statistics it would thus occupy sixth place—after Marseilles (8,100,000), Rouen (5,300,000), Bordeaux (4,000,000), Havre (3,600,000), and Dunkerque (3,100,000). But in giving assistance to Strasbourg the whole of France will be benefited. The economic influence of the port does not stop with the limits of the town or of the department. Even before the war merchandise could be shipped by Strasbourg for not a franc more than it would cost by way of Havre or Rouen or Marseilles. The Treaty of Versailles has enormously increased the commercial hinterland of the port, opening up to it the richest and most populous of French provinces. The port likewise can aspire to be a center of supply and a market for other nations, Switzerland and Italy upstream and oversea countries downstream.

"It is as a real Rhine power that France stands on the banks of the Rhine," writes M. Gaston Haelling. The port of Strasbourg is the bridgehead of this power.

THE FORTY-FIFTH PARALLEL: A DETAIL OF THE UNGUARDED BOUNDARY*

By Lawrence Shaw Mayo

When James I granted the first Virginia charter in 1606, he found it necessary to set limits to the territory which he thus placed at the disposal of a favored group of his "loving and well-disposed subjects." The southern and northern bounds appointed in the document were 34° and 45° respectively; but why these parallels were selected can be only conjectured. All we know is that here is the first appearance of the 45th parallel as an American boundary. From this, one might be led to assume that the present northern limit of Vermont and New York—that shelf-like indentation in our Canadian boundary—finds its origin in the Virginia Charter of 1606. But such is not the case. Merely by coincidence is that line the same as the original northern boundary of James's Virginia. The true genesis of our international boundary from the Connecticut to the St. Lawrence is found not in an English but in a Dutch charter.

Origin of the Forty-fifth Parallel as a Boundary

In 1614 Adriaen Block returned to the Netherlands after an interesting cruise along the American coast from Manhattan Island to Nahant, Mass. Thereupon the owners of the ship he had sailed and a few associates petitioned the Dutch government for a grant of land in those distant parts. With complete disregard for England's claim to the whole continent in general—and to her recent Virginia grant in particular—the States General of the United Netherlands granted to them, for three years, exclusive rights in North America between the 40th and the 45th parallels.[1] In this manner the Dutch for the first time defined their territorial claim in the New World and incidentally gave the undreamed-of states of New York and Vermont their present northern boundary. How the line persisted through the centuries is an interesting story.

For almost a hundred and fifty years the parallel was an international boundary, first between the Dutch and the French[2] and later—from the French point of view at any rate—between the French and the English. There are indications that the authorities of New France even went so far as to make observations and to locate the line.[3] Then came the Seven

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* Following the general sketch of the history of the boundary between Canada and the United States, "The Unguarded Boundary," by J. W. Davis, in the *Geographical Review*, Vol. 12, 1922, pp. 585–601.

[1] Documents Relative to the Colonial History of the State of New York Procured in Holland, England and France by John Romeyn Brodhead, 10 vols., Albany, N. Y., 1853–1858; reference in Vol. 1, p. 11.

[2] *Ibid.*, Vol. 8, p. 3.

[3] *Ibid.*, Vol. 7, p. 874.

Years' War, the conquest of Canada, and the consequent giving of boundaries to the newly acquired province of Quebec. The last of these was accomplished by the Royal Proclamation of October 7, 1763.

As an Interprovincial Boundary

Establishing a southern boundary for Quebec meant incidentally giving northern boundaries to New York and New Hampshire, including that disputed area known as the New Hampshire Grants. When France was on the north the British had done their best to forget the 45th parallel as a boundary. The farther north they could push their frontier towards the St. Lawrence the better.[4] But now the situation was different. A line was to be drawn separating two British provinces, and there seemed to be none more appropriate than the 45th parallel. So it came about that the latitude of 45° became the southern boundary of Quebec and the northern boundary of New York from the St. Lawrence eastward to—what point? Logically it should have run to the west bank of the Connecticut, for that was the eastern boundary of New Netherland as granted to the Duke of York by his brother Charles II in 1664. But for some inscrutable reason the Board of Trade chose instead to terminate it at the ridge of high land in eastern Vermont which divides the streams flowing into the St. Lawrence from those emptying into the Connecticut. Apparently the members of the Board were aware that the northern boundary of New Netherland was reputed to have been the 45th parallel, but they had not yet refreshed their memories as to the eastern limit of that domain. Feeling that they were free agents, they saw no reason why the parallel should continue as a boundary any farther than this St. Lawrence-Connecticut divide, which promised to make an admirable line of demarcation between Quebec on the north and New Hampshire and the province of Maine on the south. They drew the line accordingly, as the accompanying reproduction of one of their contemporaneous maps illustrates. The 45th parallel, from the St. Lawrence to the "highlands," was now established as an interprovincial boundary.

Locating the Parallel

In the summer of 1766 Governor Moore of New York wrote to the governor of Quebec, suggesting that since the 45th parallel had been officially declared to be the boundary between their respective provinces it might be well for them to ascertain its location. As Moore intended to go to the Mohawk country sometime during that season for a conference with some Indian chiefs, he proposed that Governor Murray should come down from Canada and meet him at the northern end of Lake Champlain. There they would determine the line together. "I shall," he declared, "on this occasion endeavour to obviate any disputes which [may] arise in futuro, and shall not trust to my own skill and judgement, but shall take with me the Mathematical professor of the College here, and a very fine instrument now in his possession, and every observation made will be in the presence of several Gentlemen of Fortune in this Province who have promised to attend me in this troublesome expedition."[5]

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[4] New York Colonial Documents, Vol. 8, p. 103.

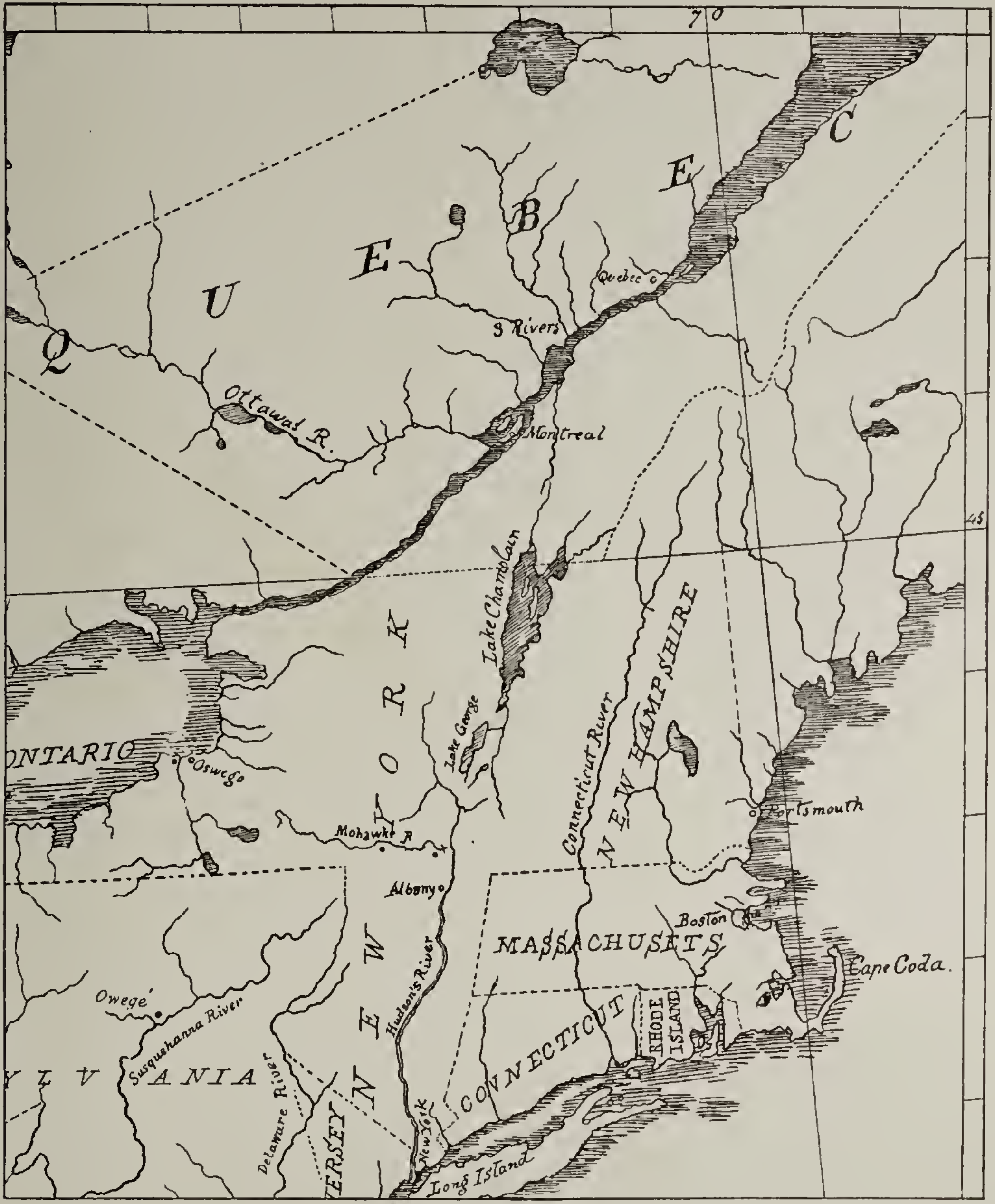

FIG. 1—Portion of a map accompanying a Board of Trade report dated 1768 and showing the northern boundary of New York and New Hampshire as established by the Proclamation of 1763. Reproduced on a slightly reduced scale from the map in "Documents Relative to the Colonial History of the State of New York," Vol. 8 (see footnote 1).

Since the governor of Quebec happened to be in England at the time, the business devolved upon the newly appointed lieutenant governor, Brigadier Guy Carleton, who went out to Quebec by way of New York. Soon after his arrival in the summer of 1766, Carleton and Moore set out together and in the course of time reached the northern end of Lake Champlain.[6] There they attempted to discover the location of the 45th parallel but were handicapped by two circumstances: bad weather and, to a greater degree, by a lack of agreement in the instruments used. Mr. Harper, "professor of Mathematicks for the Province of New York," who depended upon "an astronomical quadrant," placed the parallel five or six miles farther south than did John Collins, Esq., deputy surveyor for the province of Quebec, who worked with Hadley's quadrant.[7] This was rather odd, for in each case the man made his own province smaller than did his adversary—an occurrence which is perhaps unique in the history of boundary disputes.

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[5] *Ibid.*, Vol. 7, pp. 850–851.

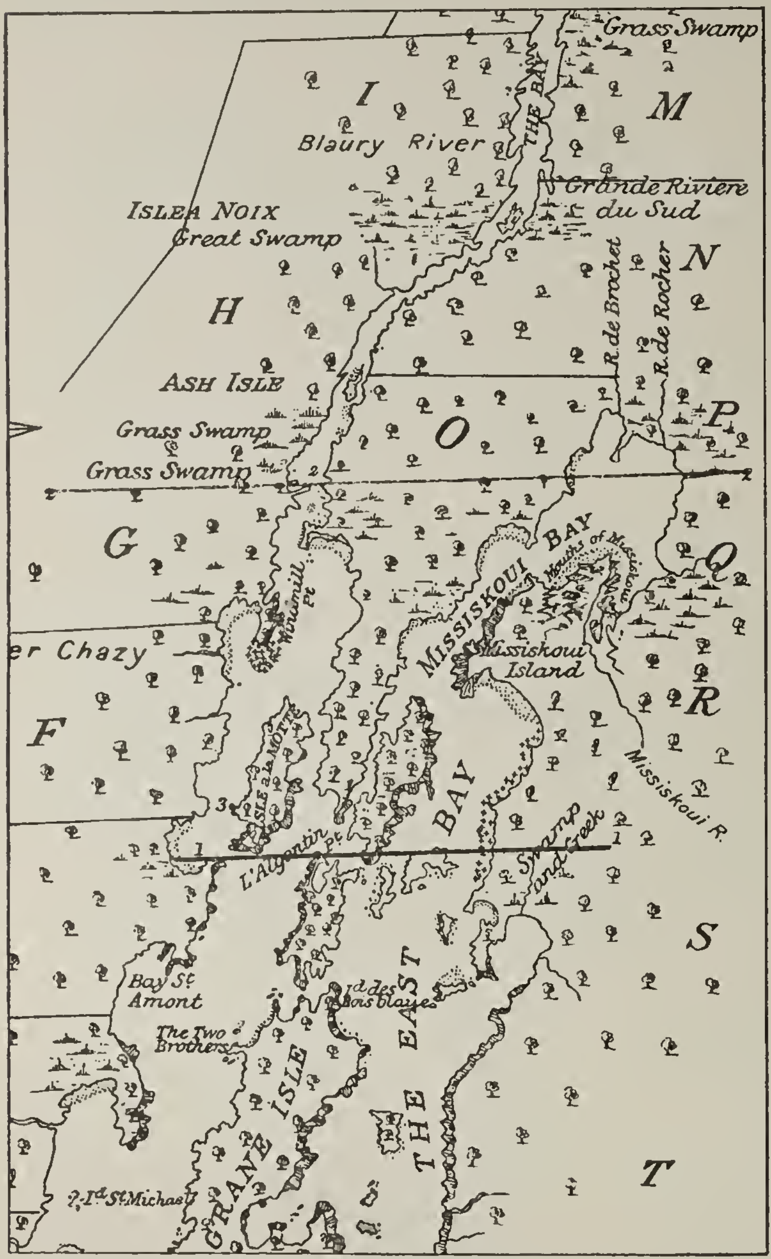

FIG. 2—Portion of the map "A Plan of Lake-Champlain" by Harper and Collins, 1766, showing the 45th parallel as located by each. Line 1 (south of Isle à la Motte) is drawn "agreeable to the first Solar Observation with the Astronomical Quadrant by Mr. Harper;" line 2 (south of Grass Swamp) "agreeable to the several Observations taken with Hadley's Quadrant by Mr. Collins." Reproduced on half the scale of the original, which is 4 miles to the inch (see footnote 7).

When instruments disagree, with whom shall the decision rest? In this case the quadrant with the greater reputation carried the day. This was Hadley's quadrant,[8] the Canadian surveyor's instrument, which, as we have observed, placed the 45th parallel at a point at least five miles farther north than the New Yorkers claimed. Thus the 45th parallel was located, and thus a starting point for the northern boundary of New York and of the

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[6] New York Colonial Documents, Vol. 7, p. 874.

[7] Acts of the Privy Council of England, Colonial Series, Vol. 6, "The Unbound Papers," H. M. Stationery Office, London, 1912, Appendix ii, map 6.

[8] According to Adams's "Geometrical and Graphical Essays" (London, 1797), pp. 253–255, "Hadley's quadrant or sextant is the only known instrument on which the mariner can depend for determining with accuracy and precision his latitude and longitude. It is to the use of this instrument that navigation is indebted for the very great and rapid advances it has made within these few years."

New Hampshire Grants from the St. Lawrence eastward to the St. Lawrence-Connecticut divide was determined. So far, so good.

Between the time of the Proclamation of 1763 and the determination of the 45th parallel in 1766, the long-standing dispute between New Hampshire and New York concerning the territory now known as Vermont was definitely settled. By an Order in Council, issued in the summer of 1764, New Hampshire was unequivocally bounded on the west by the west bank of the Connecticut, and New York won her claim to the country between that river and Lake Champlain. According to the terms of the Proclamation, the northern boundary of this area was, as we have seen, the 45th parallel from Lake Champlain to its intersection with the watershed separating the rivers flowing into the St. Lawrence from those flowing into the sea. At that point, which is about twelve miles from the Connecticut River, the boundary parted company with the oft-mentioned parallel and pursued its sinuous course along the highlands, giving New York (Vermont) a short panhandle at its northeastern extremity.

THE ROYAL CONFIRMATION

The 45th parallel having been located to the satisfaction of both governors, the next step was to obtain royal confirmation of their achievement. Moore, therefore, wrote to the Lords of Trade and in course of time received assurance from the Secretary of State that such confirmation would be forthcoming.[9] Nor was he disappointed, for on August 12, 1768, an Order in Council was issued confirming the 45th parallel as "mutually agreed upon between Sir Henry Moore and the Commander in Chief of the Province of Quebec."[10] But His Majesty, with the advice of his Privy Council, went further and ordered "that the said Line of Division be run out as far as each Province respectively extends."[11] This meant, of course, that the northern boundary of New York should thenceforth follow the 45th parallel from the St. Lawrence straight through to the Connecticut, paying no attention to the watershed between the St. Lawrence and the Connecticut Rivers and so giving to Quebec the panhandle which from 1764 to 1768 had been a part of New York.

The thing was done by the stroke of a pen and in all probability quite unintentionally. A careful search among the Colonial Office papers in London, at any rate, has yielded no evidence that George III and his advisers thought they were doing anything more than identifying the boundary which had been established by the Proclamation of 1763 and ordering that its course through the wilderness be traced. What they did, however, was to cut a few square miles from the top of New York (Vermont) and restore the ancient northern boundary of New Netherland as far to the eastward as the Duke of York's grant had extended.

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[9] New York Colonial Documents, Vol. 7, p. 885; Vol. 8, p. 35.

[10] *Ibid.*, Vol. 8, p. 88.

[11] *Ibid.*, Vol. 8, p. 88.

Running Out the Line Eastward from Lake Champlain

The 45th parallel was located in the summer or autumn of 1766. In August, 1768, was issued the Order in Council demanding that the line be run to the limits of each province. Two years more elapsed before definite steps were taken by the New York government to carry the order into execution. The winter of 1771, however, witnessed considerable progress in this direction. Lord Dunmore was now governor of the province. Early in February he sent a message to the Assembly urging them to provide for defraying one-half the expenses of running the New York-Quebec boundary; the other half, of course, would be borne by the Canadians. The Assembly responded promptly; and in the following summer Joseph Smith, representing New York, and John Collins, deputy surveyor general of Quebec, met on the shore of Lake Champlain. They began operations about the middle of August. Before the approach of winter obliged them to desist, Smith and Collins had run the "partition line" about twenty-two miles eastward from the lake. Their bill for "sundrys" is an interesting document. It totals £146 6s. 6½d. Of this amount the men's wages were £51 3s. A "Quarter Cask of Madeira" was £16; "Mr. Morrison's bill for Rum and Wine" was £10 7s. 4d.; six gallons of French brandy were £2 8s.; and they "paid the Cooper for Kegs and drawing off a Cask of Wine at Quebec" £1 1s. 7d. Yet some have marveled that the line they surveyed was so far from straight!

In the meantime Lord Dunmore had been succeeded in office by Governor Tryon. The new executive was almost unreasonable in his zeal to complete the running of the boundary. The winter had scarcely begun before he informed the surveyor general of New York that he should expect him to be on the Quebec line with his "assistants and attendants" on the first day of March to resume operations. Had the governor no heart? Or was he merely unacquainted with the climate of northern New York? Under the circumstances one can hardly blame the surveyor general for begging off. "As I have had several attacks of the Gout," he wrote to Tryon, "not only in my feet but likewise in my stomach, and dayly feel simptoms of it hanging about me I have great reason to be aprehensive that travelling and laying in the woods in the cold months of February and March might bring a severe fitt of that disorder again upon me which would not only retard the Service but would endanger my life."[12]

As the Governor did not insist that his surveyor general undertake the work in person, the latter found an agent in one Thomas Vallentine, for whom apparently the frozen north had no terrors. He was instructed to meet the Canadian surveyor and to "continue the same Line untill you arrive at the western Banks of the main Branch of Connecticut River that Crosses the Forty Fifth Degree of northern Latitude." Also "in running the said Line care must be taken to blaze the Trees on the East and west Sides as you pass along Cuting down only such Trees as stand directly in the sight of the Compass, and at the Distance of every three miles laying together a large Heap of Stones, and cutting a few knotches on the Trees nighest each pile of Stones."

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[12] The documents on which this and the ensuing statements are based are printed in the "Report of the Regents of the University on the Boundaries of the State of New York," Albany, 1884, Vol. 2, pp. 7–43.

In February, 1772, therefore, Vallentine set out for Lake Champlain. About the same time his associate, Collins of Quebec, who had been staying for a few weeks in what he termed "that miserable place Albany," also started north. The weather must have been unusually mild, for in crossing the lakes some of the horses of Collins's expedition broke through the ice and were drowned. This misfortune and a report that the ice on Lake George was covered with about a foot of water induced Vallentine to proceed slowly. Nevertheless he arrived at the rendezvous, "River La Cole," early in March and found Collins waiting for him. After a few days had been spent in organization, the party, consisting of Vallentine, Collins, and about twenty men, disappeared into the wilderness. Presumably they emerged about the middle of April, the streams becoming impassable at that season. Operations were resumed, however, towards the end of June; and on the last day of September, 1772, the expedition reached the Connecticut River "Two mile and five Eighth of a mile upon a Direct line above the mouth of Halls Brook, Distance ninety mile and one fourth of a mile from the Boundary fixed on Lake Champlain." "On the west bank of the river," wrote Vallentine, "we Put up a Squared Post and laid a quantity of Stones about it and had all the Trees and bushes for some distance around it cleared away to render it more conspicuous." Apparently he and Collins were satisfied with their achievement, as well they might be. The only complainants were the Indians through whose territory the boundary ran. "The Abenaku Savages are much displeased," Vallentine added, "with the course of the Line, say their Hunting Grounds are encroached on, and pull'd down a Post that we erected on the East Bank of Lake Mamraabagak."

Westward from Lake Champlain

Then came the question of tracing the 45th parallel westward from Lake Champlain. In the winter of 1773 the Assembly authorized the governor to have this work undertaken. The Quebec government concurred, and the surveyors were directed to commence their labors early in June. It was intended that the personnel of the commission should be the same as in the previous year, but it turned out otherwise. In the middle of May, Vallentine was obliged to inform the lieutenant governor of Quebec that he would not be able to take the field until after the appointed time because of "a Bilious Complaint, attended with a Cholic in my Bowels, and a Lax, which in a few days reduced me to a very weakly Situation." With the assistance of Dr. Hope, however, he had happily obtained relief from the "Cholic" and expected to be a well man before the first of July.

The point of all these remarks was that he trusted that the running of the line might be deferred until he was able to be one of the party.

When the lieutenant governor of Quebec reported Vallentine's indisposition to Governor Tryon of New York, he supported his account with a very dismal certificate of Mr. Vallentine's ill health signed—ironically enough—by Dr. Hope. Whatever degree of sympathy the governor may have felt for Vallentine he agreed with his colleague at Quebec that the determination of the boundary was too important a matter to await the doubtful recovery of New York's agent. A substitute was appointed forthwith—a man named Sauthier; and he and Collins finally met on the west shore of Lake Champlain in August. By the middle of October they had run the line fifty miles westward. Then came the inevitable autumnal rains which obliged them to stop work until a more favorable season. Collins guessed that they had only ten miles to go and declared it to be "a great pity" that the line could not be completed then and there. But that seemed to be out of the question.

During the following winter Collins made the two provinces a proposition. He would complete the survey for a flat sum of £100. As he seemed to Governor Tryon to be "a gentleman in the integrity of whose conduct in the faithful performance of that service an entire confidence may be placed," New York accepted his offer and entrusted to him alone the location of the remainder of her northern boundary. Collins then proceeded and sometime before November, 1774, extended the line to the St. Lawrence River. At last, after six years, the provision of the Order in Council of August 12, 1768, had been carried into effect. The 45th parallel had been "run out as far as each Province respectively extends"—a phrase which had been interpreted to mean from the western bank of the Connecticut River westward to the St. Lawrence.

Inaccuracy of the Survey

For more than twenty years the boundary established by Collins, Smith, Vallentine, and Sauthier stood unchallenged. In 1774 the British government extended it, on paper at any rate, to the eastern bank of the Connecticut as the southern limit of Quebec. In 1783, as a result of the American Revolution, it became an international boundary, and its eastern extremity was set at the middle of that river, or, according to New Hampshire's interpretation, at the middle of its northwestern tributary, Hall's Stream. In 1791 the portion lying east of Lake Champlain became the northern boundary of the new state of Vermont. But no one questioned the accuracy of the survey until 1796. Then a Mr. William Coit of Burlington informed the Vermont Assembly that he and Collins had examined the line and had found it well south of the 45th parallel. The Assembly took no action at this time,[13] but in 1804 Governor Tichenor agitated the matter again.

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[13] Records of the Governor and Council of the State of Vermont, Vol. 4, Montpelier, 1876, p. 115, note 2, citing "Journal of the Assembly of the State of Vermont for 1796," pp. 113, 114, and 133.

At his instigation the Assembly in the following year passed an act empowering him "to employ some person of competent knowledge" to ascertain where the 45th parallel crossed Lake Memphremagog and also its intersection with the Connecticut River.

This Governor Tichenor endeavored to do. For the work in hand he engaged the services of the Rev. Samuel Williams, LL.D., of Rutland, whose chief claim to distinction lay in a history of Vermont which he had written and published in the previous decade. Among his contemporaries Dr. Williams enjoyed a considerable reputation because of his erudition, but let us hope that his historical writings were more accurate than his astronomical observations proved to be on this occasion. In May, 1806, Dr. Williams found the original wooden monument which Collins and Vallentine had erected on the Connecticut River in 1772. After taking a number of celestial observations he declared that the old line was 12′ 1″—approximately fourteen miles—south of the 45th parallel. Then he moved on to the east bank of Lake Memphremagog, where he went through a similar procedure and pronounced the existing line seven miles too far south. Assuming that the marker on the shore of Lake Champlain was placed correctly, he computed that the deviation of the line between that point and the Connecticut had robbed Vermont of more than 400,000 acres.[14] These facts—or rather fancies—he reported to the governor and returned to his parish in Rutland. On the other hand, about this time the provincial government of Lower Canada was receiving a number of communications which led it to suspect that the line was really north of latitude 45°. In 1807 the Canadian surveyor general made an official report in which he stated that the line was evidently crooked and that he believed it to be as much as three miles too far north at its intersection with the Connecticut.[15] It is not surprising, therefore, that when the War of 1812 was brought to a close in 1814, a clause was inserted in the Treaty of Ghent declaring that the boundary line from the Connecticut westward to the St. Lawrence had "not yet been surveyed" and providing for the creation of a commission to take charge of the matter.

EFFORTS OF THE COMMISSION APPOINTED UNDER THE TREATY OF GHENT

The commissioners appointed were Thomas Barclay for Great Britain and Cornelius P. Van Ness for the United States. Their official meetings began at St. Andrews, New Brunswick, in September, 1816, and ended—in disagreement—at New York in October, 1821. The location of the 45th parallel was, of course, not the only problem which confronted them, but it is the only one which concerns us here. The information laid before the commission was indeed disconcerting. In the autumn of 1818 both the British astronomer and his American associate discovered that the true 45th parallel lay about three-quarters of a mile south of the "Old Line."[16] Except for its effect upon the reputation of Dr. Williams this discovery would not have been so disturbing, if the United States had not recently constructed a fort on territory which now appeared to be British. The fort stood on Rouses Point, a commanding peninsula at the northern end of Lake Champlain. It was about a half-mile south of the "Old Line" but clearly north of the true parallel. The astronomers were horrified and at first kept very quiet about their discovery lest it should precipitate a local uprising. Further observations made it evident that the Collins-Vallentine line was inaccurate and erratic throughout its course.

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[14] His report is printed in the "Report of the Regents of the University on the Boundaries of the State of New York," Vol. 2, Albany, 1884, pp. 46–49, and in "Records of the Governor and Council of the State of Vermont," Vol. 5, Montpelier, 1877, pp. 454–455.

[15] See the article "Northeastern and Northern Boundary," *North American Rev.*, Vol. 33, 1831, pp. 262–286; reference on p. 282.

The American agent, William C. Bradley, whose duty it was to present the American argument to the commission was in desperation. There was no longer any doubt as to the true location of the 45th parallel; but something must be done to save the fort for his country. As the eighteenth-century boundary had been the work of provincial officers carrying out the instructions of the British Crown, Bradley's first argument was that it should stand, regardless of the true 45th parallel. If the commission would not agree to this he declared he should be obliged to argue in favor of the *geocentric* latitude, as distinguished from the *observed* latitude, which would throw the parallel thirteen miles farther north.[17] The commissioners could not agree upon his first suggestion. As to his second, both agreed that it was preposterous!

In accordance with the terms of the Treaty of Ghent, therefore, the matter was now referred to an arbitrator.

Decision of the King of the Netherlands as Referee

The King of the Netherlands was the arbitrator agreed upon by Great Britain and the United States. After three or four years of deliberation he made his award on February 10, 1831. To him it was clear that the best solution of the 45th parallel difficulty would be to adopt the true line with the exception of a bit of territory near the fort at Rouses Point. There an arc with the fort as its center and a radius of one kilometer should be described. All the territory included therein should be given to the United States. From a distance of ninety years this recommendation appears as fair as it was ingenious. Unfortunately, the terms of the arbitration called for a judgment for one side or the other and did not authorize the recommendation of a compromise. The British government was ready to accept the arbiter's proposition, nevertheless. But not so the Senate of the United States. By it the award was repudiated in July, 1832.

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[16] J. B. Moore: History and Digest of the International Arbitrations, to Which the United States Has Been a Party, 6 vols., Washington, D. C., 1898; reference in Vol. 1, p. 80.

[17] *Ibid.*, Vol. 1, p. 112.

The Webster-Ashburton Settlement

Another decade passed, and the northern boundary of Vermont and New York remained undetermined. In the meantime, however, the lack of a definite frontier for the state of Maine and other causes of friction between Great Britain and the United States made necessary a new treaty between the two countries. Happily for the young republic its part in the negotiations was carried on by Daniel Webster. He had accepted the office of Secretary of State in President Harrison's cabinet in 1841 and after Harrison's untimely death continued at the head of foreign affairs under the succeeding president, John Tyler. Webster was convinced that the proper method of establishing the northeastern boundary, including the 45th parallel, was to agree upon a conventional and arbitrary line. When his sentiments became known in Downing Street the British government greeted them with favor and sent Lord Ashburton to Washington to settle the question on this basis. He arrived at the American capital in April, 1842, and the negotiation began forthwith. As a result of their policy of give and take, Webster and Ashburton created a northeastern boundary that proved satisfactory to a majority of all concerned. The northern limits of Vermont and New York were finally set, not at the true 45th parallel but along the inaccurate, eighteenth-century line of Collins and Vallentine. Thus seventy-five years after Governors Moore and Carleton erroneously located the 45th parallel on the shores of Lake Champlain, and almost seventy years after Collins completed their work by running the line of division to the extremities of both provinces, that line—and not the limit set forth in the Treaty of 1783—became the legal international boundary from Hall's Stream, the northwestern tributary of the Connecticut River, to the St. Lawrence. And thus did error ultimately triumph over accuracy.

When the government surveyors entrusted with the exploration and marking of the boundary established by the Ashburton Treaty came to the Collins-Vallentine line they identified it by the blazes still remaining on the trees of the forest. To verify the evidence they cut into some of these marks and found scars deep-seated in the trees. By counting the rings from these scars to the bark they computed that these were indeed the original blazes made by Collins and his associates in the early 1770's! Their report upon the relation of the line thus determined to the true 45th parallel will complete the story.[18]

"The boundary along the west line, though very far from being a straight line, is generally about half a mile north of the true parallel of latitude 45°, from Hall's stream [of the Connecticut River] to Rouse's Point. At about twenty-eight miles west of Rouse's Point it, however, crosses that parallel to the south, until it reaches Chateaugay river, where it bends northwards, and, crossing the parallel again, about four miles east of St. Regis, it strikes the St. Lawrence one hundred and fifty-one feet north of 45°."

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[18] *Senate Exec. Doc., No. 71, 30th Congr. 1st Sess.*, p. 8.

THE GEOGRAPHICAL STUDY OF POPULATION GROUPS*

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How Population Is Studied

The literature of population is relatively small. To realize this, one has only to consult the subject index of a large library. The important works on the subject start with Benjamin Franklin and Malthus and run down through the nineteenth century fairly regularly, ending with Carr-Saunders in 1922. The uniform character of the investigations is very striking. They nearly all deal with the matter from the standpoints of statistics, economics, or eugenics. Geography is not represented.

A vast knowledge of the distribution of man on the earth has accumulated during the statistical period. His preferred habitats are thoroughly known; his rate of growth in them is known; and the general nature and trend of his movements from place to place are known. The numerical study of man is on a sound basis and has been exhaustively investigated by the mathematicians. Nations can hence compare themselves with other nations in a rigorously quantitative manner and are now psychologically dominated either by the fear of numerical inferiority or by the pride and strength of numerical advantage.

Political economy has analyzed the growth of mankind and is able to show that subtle relations exist between occupation and rate of increase, between the industries of peoples and the fecundity of certain classes of human beings, between national revenue and prosperity as measured by numbers; and has shown that national wealth and power are in a great measure functions of the resources of the national or imperial land bases. "Be ye fruitful and multiply: seize the good places of the earth and use them!" This advice has been followed with an intensity that may well be regarded with anxiety.

The eugenists have examined the conditions of life and the quality of the human harvest. They are dissatisfied. They see the squalor and poverty of the towns and cities and the deterioration of mind and physique among slum dwellers. They note that along with increasing wealth and progress is a parallel development of misery. Eugenic study has produced two very active campaigning minorities: the advocates of preventive checks of population growth and the town planners. The latter need only a knowledge of the existence of the field in order to become geographers. Thus far has the study of population brought us. We have a majority faith in the desirability of numbers and a minority apprehension that quantity is lowering quality.

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* Read before the Association of American Geographers, Ann Arbor Meeting, December, 1922.

Among the qualified prophets there is no unanimity, but they incline towards a faith in numbers.

WHAT HAS GEOGRAPHY DONE?

If the geographer be asked for succinct and useful information on population he is able to point to endless tables of figures taken from the statistician. He is able to produce innumerable maps of the world, of countries, regions, and districts, showing the density of population depicted according to arbitrary administrative subdivisions. He can point to the fact that more people live on the coal fields of Westphalia, or the alluvium of the Ganges, than on the veld. The facts are interesting, and the reasons rather obvious. He can produce curves showing the growth of all the leading cities of the world and can tell you just why Detroit has grown, if you don't happen to know. He can tell you anything about numbers, provided you ask him to deal with them under the subdivisions of cities, towns, and "remainder." The maps, except those of Sten De Geer (admirable, expensive, and difficult to file), are not geographic maps. Inevitably their information as a whole or in detail is generalized and lacks precision. For the merchant the geographer has handy information on the habits and occupations of all the peoples of the globe and can point to markets.

The coherent and obvious population groups have been studied in their relation to the configuration of the land, and a large amount of information exists about the positions of cities, the sites of towns and villages, and the locations of dwellings. This information has not yet been treated exhaustively and has yielded few principles. It is useful and indicates a lead to one of the objectives of science—prediction. It is known that Paris has grown because it is in the right place; that the villages of Macedonia are often definitely related to fault scarps; that the Mormon communities of Utah have wisely placed themselves on the fans at the canyon mouths. Numerous towns have been studied as objects in the landscape, with fruitful results. The town is seen to be composed of definable units, and we are coming to understand their interdependence and to control their growth. These studies, however, are in their infancy.

During the past twenty years the regional movement has asserted itself as a definite policy in geography and bids fair to spread to other sciences such as climatology, biology, and even sociology. The subdivision of the earth into regions is the beginning of a reliable stock-taking of world resources. The configuration of the globe determines its occupation by mankind. The climatic limitations of the region will eventually determine who shall be the occupant. The climatic limitations also control the natural fecundity of the region in plant and animal products. The regional view will show us the deficiencies and surpluses of the various parts of the earth and will enable us to understand our final interdependence. The capacity of the region will set a limit to its use.

The status of the region is still in debate. Some deny the reality of its existence. Others hold that delimitation cannot be placed on workable principles. Still others dispute the criteria of unity which have been selected. Nevertheless, the regional movement is steadily gaining adherents from the soundest ranks of geography, and the subdivision of the globe into world regions, climatic regions, physiographic provinces, and natural districts may, I think, be confidently expected in the near future. It can only be done satisfactorily by a survey method, and the existing regional maps are no more than the results of reconnaissance and reasonable speculation.

The results for geography, then, are slight, the ground being barely broken. Little definite information is in existence, and no useful contribution to the population problem can be made at present. The line of attack, however, is discernible. I am aware of only one attempt at a direct contribution to the problem by a professed geographer.[1]

The Geographical Confrontation

We know where the people of the earth are. We know in some measure why they are there. We know what enables them to live there. Can we say how many will be able to maintain themselves in a given region? And under what conditions?

These, it seems to me, are the geographical objectives in the investigation of the population problem. But how is geography to confront the problem, and with what equipment is it armed? The investigator needs a philosophy of population. Is he to be a champion of uncontrolled increase and ruthless exploitation of the earth, or of controlled increase, if that be possible, and a wise use of resources? His opinion will be based upon the conclusions of the economic investigators, modified by his own geographical knowledge. The conclusions of the economists, however, are strongly tinged with nationalism or colored by national environment.

In the United States we find Thompson[2] aligned unequivocally with Malthus and regarding France as the well-advised and fortunate follower of a sound doctrine. His position, based on a careful interpretation of Malthus, from first-hand and intimate knowledge, is a very firm one. He is strongly supported by East, whose argument is the result of an extensive inquiry into the agricultural resources of the country.[3] East has estimated a maximum capacity for the United States, under conditions like those of the present, and his results are in striking accord with those of Pearl and others, who arrive at a principle of population maxima from the mathematical interpretation of increase regarded as a growth phenomenon.[4]

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[1] G. G. Chisholm: Geography and the Population Question, *Geogr. Teacher*, Vol. 9, 1917–18, pp. 54–57.

[2] W. S. Thompson: Population: A Study in Malthusianism (Columbia Univ. Studies in Hist., Econ., and Public Law, Vol. 63, No. 3), New York, 1915; reference in Ch. 9.

[3] E. M. East: Population, *Scientific Monthly*, Vol. 10, 1920, pp. 603–624; *idem:* The Agricultural Limits of Our Population, *ibid.*, Vol. 12, 1921, pp. 551–557.

[4] Raymond Pearl and L. J. Reed: On the Rate of Growth of the Population of the United States Since 1790 and Its Mathematical Representation, *Proc. Natl. Acad. of Sci.*, Vol. 6, 1920, pp. 275–288.

Raymond Pearl and F. C. Kelly: Forecasting the Growth of Nations, *Harper's Mag.*, Vol. 142, 1921, pp. 704–713.

In France economic propaganda are vigorous at the present time, the slogans being "avoir beaucoup d'hommes; faire rendre le maximum à la terre; fabriquer à force de machines; étendre le commerce de mer; associer les colonies à l'effort national." These measures are advocated by Demangeon,[5] and an elaborate argument for the increase of French population by increasing French production has been put forward by Lascaux.[6] He shows that production and population are undoubtedly linked intimately and concludes that France must have more people and can only do so by feverish efforts at production. The French economists are almost unanimously anti-Malthusian, their condemnation of the pioneer resting upon criticism of the arithmetical ratio. The leaders of France demand a great population, but the French people pay little heed to them. The demand seems to spring from a fear of the wealthy and populous nations. And yet France is a happy and prosperous country; and, moreover, the land of France is full. Tillage has expanded until there is little ground left to till, and the land seems to be occupied by a maximum of people. I have only seen this view expressed in print once and that in a volume on birth control which contains several very illuminating essays.[7]

The English interpretation, as expressed in an important work by Carr-Saunders, aligns itself in some measure with that of Pearl. It implies that these things are operating according to some law and that they will, in a way, look after themselves. Carr-Saunders looks to the development of an optimum density of population, changes in numbers coming about in response to economic requirements. Increase of population brings industrial returns up to their optimum, if they are below it, and vice versa. This may well be true in an isolated and closed system and in its broadest sense may be true as a whole, but one may query whether or not the condition of optimum returns is desirable or whether the adjustment from conditions that have gone past the optimum is a comfortable process.[8] A different viewpoint is exhibited by Darwin, who evaluates civilization according to the possession of wealth, stock, and tradition, recalling Fleure's three aims of humanity, life, new life, and good life. Darwin makes a reasonable deduction to show that civilization depends ultimately on wealth and concludes that "any increase in our numbers must, therefore, now react injuriously on our civilization, both directly by lowering average natural endowments and indirectly by causing a diminution of average wealth."[9]

Those who have watched the world filling up, who have seen the colossal efforts that were required to feed England during the war, who have considered the delicate balance of world economics and realize how easily that balance is upset, who foresee the growth of the exporting countries and the probable diminution of their ratio of export, who have studied the exodus from countries endeavoring to arrive at their optimum density of population after having exceeded it,[10] will most likely agree with Mackinder, that the oceans of the world are now a closed sea, and will incline towards a Malthusian view of the population problem. Dr. Fenneman said before this Association in New York in 1921 that "the world is filling up, and the time is coming for Africa to do its share in providing food." World population is increasing at a very rapid rate, and the most conservative estimates of future populations render the prospect of feeding them a very formidable task. No matter what laws the increase will obey, geography confronts the questions "Where are all these people going to live? How are they going to live? and What resources can be made available for their sustenance?"

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[5] Albert Demangeon: Le déclin de l'Europe, Paris, 1920, p. 294.

[6] Robert Lascaux: La production et la population, Paris, 1921.

[7] Population and Birth-Control: A Symposium, edit. by Eden and Cedar Paul, New York, 1917, p. 294.

[8] A. M. Carr-Saunders: The Population Problem: A Study in Human Evolution, Oxford, 1922.

[9] Leonard Darwin: Population and Civilisation, *Econ. Journ.*, Vol. 31, 1921, pp. 187–195.

The Population Groups

Professor Barrows in his presidential address used the term "human ecology." The study of population groups is precisely this and is hence a biological investigation. "We are concerned with the interactions between society and its surroundings. Society, the collective organism, is the highest expression of the organism, and for its own maintenance it sets aside organic groups, largely expressed as towns and cities. These may be examined according to function (physiologically), according to form (morphologically) as Fleure has done, or according to tissue (histologically)."[11]

In size, the elements of the groups range from the conurbations of Geddes down to the isolated families of rural districts of dispersion. The group itself is the intimate expression of its region and in many examples exhibits a marginal fusion, or dovetailing, with the groups of neighboring regions. This relation does not obscure the limitations of any but the largest groups but rather rings them round and accentuates them with a solid frontier. The town is not generally the group, nor is the cluster of farms of a particular district the group; the group itself is the sum and spread of all dwellers of the region. Hence I have said above that the groups are largely *expressed* as towns and cities. The town or city points to the existence of the regional group. The clusters are always there, but the density of the halo is subject to great regional variation. In some regions, as, for example, where the regional effort takes the form of isolated mining, the halo may be entirely wanting; and at the other extreme, as on many coal fields, density may be uniform and high, as in cities, with here and there a barely recognizable centralization point or core. For these reasons I have used the term "grouping of population" to denote the regional distribution of humanity and "arrangement of population" to express the disposition of peoples forming the internal elements of the groups. Jefferson's maps, particularly of the cities of the United States, appear to me to be the first steps towards a recognition of the knotting points of the groups of the country. Careful distinction must be made between elements which exist for the service of groups of lower rank and those which exist for the service of a higher group or of groups which embrace the lower. As all the elements of a group occupy position in space, an element serving a major group must occupy a position within a lower region and may easily be mistaken for an expression of the lower region.

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[10] See "The Migration of Races," *The Round Table*, No. 42, March, 1921, pp. 241–273. London.

[11] M. Aurousseau: Urban Geography: A Study of German Towns, *Geogr. Rev.*, Vol. 11, 1921, pp. 614–616; reference on p. 616.

The town represents the culminating point of the highest activity of the group. It exists for the *production* of the results of the highest effort of which the group is capable, whether the effort be in a material or an intellectual direction or in the direction of the broadest social service. A health resort exists for social service; so also does a major traffic town. The town is thus an evolutionary development from the lower grades of production—the grades which are essential in order to maintain the existence of life. The town takes its strength from the producing capacity of the region and from its relation to the route. In a small region, say one of the Belgian natural districts, we find the central town, or district capital; the subordinate towns, evenly scattered, "en pleine région;" and, if neighboring regions be of a contrasted character, the marginal towns of the border fusion. These marginal towns, or *interregional towns*, are clearly exhibited by several Belgian districts. Between the district of the "plaine maritime" and Flanders proper we find Bergues, Furnes, Dixmude, and Bruges. Between Picardy and Flanders is the line of towns St.-Omer, Aire, Béthune, Lens, and Douai. Between Brabant and the Campine we have Malines, Louvain, and Tirelmont. Some of the towns of the fall line of the Atlantic seaboard are in this sense interregional towns. Thus, in regarding the town as a regional knotting point, distinction must be made between the central towns, the towns "en pleine région," and the interregional towns of the margin. A map of the towns of a country cannot, therefore, be used as an immediate index to the distribution of regional groups; and, before the regions can be represented with any certainty on the map, a much deeper study is required.

I am not aware of any studies dealing with population groups according to their relation to the region. Yet this treatment seems to be a necessary beginning for a physiological interpretation of the groups. In the first place we do not yet know the extent or nature, particularly, of our smaller regions. Some attempts have been made to delimit the climatic regions and physiographic provinces, and maps showing the *proposed* subdivision of the United States on these grounds are in existence. The geographic sense hints at the direction in which an interpretation may be sought. Let us take the town map of the United States and *remove* from it all cities and towns existing in the service of the larger groups. The *port* of New York serves the whole country and has but little to do with its immediate region. Salt Lake City is certainly the property of Utah, but Denver belongs to more than Colorado. Examination of the depleted map, examination of the ground, where possible, and a somewhat extensive questionnaire, say through the universities, will serve to indicate the capitals, "villes en pleine région," and interregional towns of the smaller regions. Regional survey alone will be the final test of the truth of a map constructed by these means, and it may be long deferred.

The occupants of a geographic region, then, constitute the population group. The groups of the smaller regions are integral parts of higher groups corresponding to regions of higher status, while the largest groups are influenced strongly in their development by the restrictions of nationality and the existence of political boundaries, which tend to complicate or to obscure the geographical relationships of the group. The regional treatment of the group will help to clear the ground of many difficulties. We are accustomed to speak of urban and rural peoples, for example, but hesitate to draw the line of division between them. They stand at opposite poles of the occupational series of which the group is composed, but there is seldom a true line of division between them. Professor Jefferson once said to me "the country has now delegated many of its duties to the town," and this modern delegation of duty has done much to make the transition from rural to urban activity a very gradual one. In past times it was much more clearly defined than it is now.

The group, as a regional unit of population, has not been studied. We are in possession of a great deal of information concerning the effects of environment (Miss E. C. Semple's work, for instance, is very widely known) and of the relation between climate and civilization, a contribution in the main from Ellsworth Huntington; the profound effects of geography on the course of history have been made evident by Mackinder; and the anthropologists have readily admitted and made use of the geographical factor as a determinant in race development.[12] In none of this work has the region been made the unit, and a physiological investigation of the regional groups of lower status must be the beginning of a satisfactory geographical study of population.

THE ELEMENTS OF THE REGIONAL GROUPS

If geographers have not examined the group as a whole, they have given considerable attention to the elements of the group, particularly to the towns and cities. Most of this work has been individual, specialized, isolated, and in general is of morphological or histological character. The town planners have long looked upon the town as a functional element, and I have myself endeavored to supply a classification of towns according to their functions;[13] but in general the functional interpretation is not apparent. An approach towards a morphological, regional attitude in town studies is to be seen in the work of Geddes, Fleure, and Geisler;[14] and Geddes in particular has given us the useful conception of conurbations, or regionally grouped cities. The effort of geography has been confined, however, largely to rather detailed morphological and histological investigations of individual cities. The results have appeared mostly in volume form; and we are in possession of valuable works on the geography of Rouen, Marseilles, Grenoble, Danzig, Edinburgh, New Orleans, and other cities. This work is making clear the units which compose the modern city but is not yet susceptible of yielding anything from generalization. We are prone to regard the city as an entity, rather than as a culminating point of regional effort. We speak of Athens and forget that it was the product of the Attic plain; of Rome, ignoring its base in the Campagna; of Carthage, to the exclusion of the numerous smaller Carthaginian towns and of the agriculture of the Punic region. London alone is called "the hub."

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[12] See A. A. Mendes-Corrêa: Le milieu géographique et la race, *Scientia*, Vol. 30, 1921, pp. 371–380.

[13] John Nolen: New Ideals in the Planning of Cities, Towns, and Villages, New York, 1919.

M. Aurousseau: The Distribution of Population: A Constructive Problem, *Geogr. Rev.*, Vol. 11, 1921, pp. 563–592.

[14] Patrick Geddes: Cities in Evolution: An Introduction to the Town Planning Movement and to the Study of Civics, London, 1915; reference in Ch. 2.

H. J. Fleure: Some Types of Cities in Temperate Europe, *Geogr. Rev.*, Vol. 10, 1920, pp. 357–374.

Walter Geisler: Beiträge zur Stadtgeographie, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1920, pp. 274–296.

A great deal of information concerning the positions and sites of towns and cities is easily accessible in the literature of geography and in the hands of Mackinder has yielded a most fruitful generalization in his conception of nodality. It throws great light on the underlying causes of the prosperity and decline of towns, and in competent hands it enables a wise choice of the positions of new cities to be made. The new capital of the Australian Commonwealth was "placed" by a physiographer. The principle of nodality is related to the function of the town, urban activity standing in close relation to the degree of nodality of the position.

The elements of lower-grade production within the group, the so-called "rural populations," have also been studied; and their arrangement within the region is found to be closely related to the geographic nature of the region. The region will permit them to occupy it in a certain way if their social and economic development has allowed them to come to what may be termed geographic freedom. They *tend* to occupy it in this way; and, where freedom has been attained, the region is found to exhibit domains of characteristic arrangement.[15]

At the present time all stages towards geographic occupation are to be seen among rural peoples. Those who have attained freedom endeavor to occupy the region "as they like" and are found to occupy it as the region permits. All stages, from the primitive cluster towards various kinds of dispersion, are to be seen; and some regions do not permit of any other than a clustered arrangement. The best method of occupation of others is undoubtedly some form of dispersion, and this has not been taken into account by the rural reconstructionists, who demand new and better *villages*.[16] The factors which tend to maintain the primitive cluster are diverse but are nearly all economic or social in their nature. They point to stages in the evolution of society. Sometimes, among primitive folk, they are psychological and curious. In the Grenadines, for instance, the negro population of the island of Carriacou is dispersed over the plantations. On the neighboring territory of Union Island, however, the negroes, similar to those of Carriacou in every respect, are (or were, the island having been swept by a hurricane) huddled into the two small towns of Ashton and Clifton. Union Island is infested with ghosts, and the only way to "fool" the ghosts is to live as close to your neighbor as you can possibly get.[17] Similar beliefs were a stumbling block in the German efforts to induce the natives in East Africa to replan their villages on more open and sanitary lines.

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[15] M. Aurousseau: The Arrangement of the Rural Population in Picardy and Flanders, *Geogr. Journ.*, Vol. 51, 1918, pp. 393–394.
Idem: The Arrangement of Rural Populations, *Geogr. Rev.*, Vol. 10, 1920, pp. 223–240.
Idem, op. cit., footnote 13.
Marguerite Lefèvre: Carte régionale du peuplement de la Belgique, *La Géographie*, Vol. 36, 1921, pp. 1–34.

[16] Harold Peake: The Regrouping of Rural Population, *Geogr. Teacher*, Vol. 9, 1917–18, pp. 71–77.

Considerations of rural arrangement, adapted to geographic conditions, lead one to the conclusion that there is a regional limit of capacity for occupation; and I have advanced the idea of the regional expansion ratio, as a quantity capable of evaluation by proper survey. Can more than a given number of rural people live in a given region? I think not. The expansion ratio should answer the question definitely. Its workability, however, remains to be proved.

Recognition of characteristic rural arrangements is only attainable on intimate knowledge of the region. Indeed, realization of the extent and nature of the region itself depends on a close and long first-hand knowledge of a particular territory. Where these conditions have been realized, the regional scheme has in every case betrayed itself; and it is on these grounds that a personal belief in the region is founded. After two years' residence in the District of Columbia, I have only recently recognized that a very well characterized arrangement of the rural population exists in the environs of Washington. It is a hilltop dispersion, closely associated with the development of ridge routes. Good topographical maps often suggest the key to the arrangement; and Miss Lefèvre's work in Belgium was based largely on the official maps of 1: 100,000 scale, which is a very workable scale. My own results have come from examination of the ground, sometimes prompted by a suggestion from the map.

The Historic Development of the Group

It is from a systematized knowledge of the structure and function of the group, and of its historic development in its region, that a useful geographical contribution to the population problem is likely to come. How have the group and its region interacted in past times? At present we cannot say, but there are definite indications which point the way; and our first attempts must be made on the old and long-settled countries.

In Europe a mass of information and a large number of statistical estimates concerning the population of past times have been collected by the economists, and anthropologists and others have studied the origins of race and types and causes of early settlement. In Europe, moreover, population has been tied to the soil for long generations; and the most noteworthy movement has been one of exodus rather than one of internal movement, as in the

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[17] Oral communication from Dr. Austin H. Clark.

United States. Moreover, in Europe, especially in France, regional study is more advanced than elsewhere, there being a large number of papers in European geographical literature dealing with particular regions. In other words, the conditions of occupation have been relatively stable, and the regional knowledge is greater than in newer countries. The old social and economic organizations, like the village communities of Europe and parts of Asia, also possess a fairly extensive literature, which is of service to the geographer. From this last source much may reasonably be expected.

The English Village

Peake has very recently published a most comprehensive volume on the English village, from which important inferences may be drawn.[18] The village community is traced to its earliest sources, and its prototype is seen by Peake in the Alpine lake dwellings of Switzerland. From the lake dwellings sprang the nucleated village, while the dispersed village, later giving rise to the forest village in England, seems to have originated in the forested plains of Germany. The appearance of each social form in England is traced as far as knowledge permits, the modification of the form being followed in detail and ascribed mainly to racial influence. The numerous anthropological types to be found in the village itself and in the region are tracked to the distant lands of their origin. The initial geographical implication is the intimate connection existing between the village and its area (the township). The village site is given comparatively little attention; but, assuming a site to have been chosen for whatsoever reason, the community in, say a valley village in Saxon England, was dependent, through its organization, upon the possession of meadows, common fields, and waste. The surrounding lands were appropriated up to the limits of these requirements. But sooner or later there were neighboring villages. Boundaries were set to the township, and gradually its whole area became involved in the economy of village life. We must suppose that these boundaries were selected with regard to the ease and stability of their maintenance and had, therefore, certain physiographic determinants. We suggest to the English student of rural geography that there is an interesting problem awaiting investigation here. Moreover, the village had many affairs with the outside world, and to deal with them townships combined into hundreds; and we may surmise that the areal form of the primitive hundred was based upon convenience. The union of hundreds into shires would follow the same scheme, though less rigidly. We deduce that the village was a *growing* thing in a *limited* area and stood in definite relation to the smallest of geographic entities, the natural district. These ancient boundaries may give us the key to the natural districts and natural regions, where human modification has obscured their reality from the modern world. The village felt its first growing pains in the tenth century,[19] according to Peake. Adjustment was made by decreasing the size of holdings in the common fields from 120 acres, which is believed to have been the Saxon standard (per family), to about 30 acres. From then, decrease in the size of holdings became progressive. After the Norman Conquest very little beyond the nomenclature and the perspective was changed. The township became the manor, with practically the same boundaries and little change in organization, and, whereas to the Saxon the township was the unit and the kingdom a combination of townships, to the Norman the scheme was reversed; the kingdom was the unit, subdivided into townships on a military basis. The settled Norman rule led to more growing pains in the eleventh century. These were met by building more houses, which limited the extension of the common fields, and by encroachments on the waste (pasture).

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[18] Harold Peake: The English Village, The Origin and Decay of Its Community: An Anthropological Interpretation, London, 1922.

The Statute of Merton (1235) is regarded by Peake as a turning point in the history of the village. The lord, prior to the tenth century, had been a guardian of the waste. Thence on, his position of trust insidiously became one of ownership, an ownership actually legalized by the statute. Immediately large areas became privately enclosed; mansions were erected far from the villages; a severance of interests began. The village of the twelfth and thirteenth century showed marked signs of pressing seriously upon its means.[20] Combination of townships, irregularity in the sizes of holdings, the presence of assarts (enclosures of the waste), the law of stint (limitations of the rights of pasturage), and more acute restraints on the peasant, such as license to marry or to sell his oxen, all point to embarrassment of the village through increase of population in an area incapable of extension. Furthermore, towards the end of the twelfth century the old plowlands, through lack of proper manuring, were deteriorating in value.

The gradual substitution of renting tenure for servile tenure, the expansion of pastoralism, and the consequent pressure of the landed gentry on the agricultural folk, the final calamity of the Black Death, and a general decrease in soil fertility appear to have brought about the long train of enclosures which extinguished the village community. Little remained of the old system but its shadow—the ecclesiastical parish, which succeeded the manor. Peake ascribes the enclosures of the sixteenth century mainly to the spread of pastoralism, and he implies a certain depopulation of the villages (through eviction) and congestion of the rising towns (e. g. Newbury, Berkshire, 1517). From the sixteenth century onward the English village, from a geographical standpoint, loses steadily in definition. As a social entity it ceases to have much significance. As a geographical form Peake says nothing of its further modification though it is demonstrable that the movement towards free geographical arrangements has taken wide effect. The rise of the parish, in response to the need of administering the poor laws, is followed, and some interesting information concerning parish boundaries is given.

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[19] As might be expected, this process of expansion made itself felt somewhat earlier on the neighboring parts of the continent (ninth century). See Marguerite Lefèvre, *op. cit.*, footnote 15, pp. 21–23.

[20] About this period (and for some time later) the final clearing of the forests and reclamation of the marshes was being accomplished in Belgium. See Marguerite Lefèvre, *op. cit.*, footnote 15.

The towns of Germany were also realizing the need of space for growth and were making allowance for it in their plans. See Walter Geisler, *op. cit.*, footnote 14.

That the fluctuations and changes of the rural peopling of England were regional in character is fairly inferred from several sources, particularly from a neglected aspect of the enclosure movements. Peake himself noted the conspicuous distribution of the earliest enclosures and their correspondence with well-marked geological features. He points out their coincidence with the Tertiary beds of the London and Hampshire basins and with the clays of the Weald. Slater has mapped the distribution of the parliamentary enclosures of the eighteenth century, and I have called attention to the fact that their distribution is in very marked accord with that of the Mesozoic rocks of England, particularly with that of the chalk.[21] This gives great strength to the conclusions that there is a close connection between the evolution of a form of settlement and the geological foundation upon which it rests and that the grouping of peoples and the fluctuation of populations are regional manifestations.

The mere fact that enclosure occurred in England is of profound geographical significance. Why did it occur? To my mind it occurred because the townships had greatly exceeded their "optimum density of population" and it was the return to the optimum. Things overshot the mark on the return journey, and the return was revolutionary in character. Indeed, indications are not wanting to show that the adjustment to optimum density may be violently revolutionary. The same results followed at a later date in France, where, prior to the Revolution, agrarian conditions were exceedingly wretched. The peasant was revolving in a circle in which underproduction was causing poverty, and poverty was causing further underproduction.[22] The present troubles of Russia, which is still shackled with the remains of the uneconomic village-community system, are largely agrarian. The adjustments in England and France were made by a violent change in the method of occupation and tillage of the land.

Decline in soil fertility has been advanced as a primary cause of enclosure in England. Peake accepts it as a contributing cause, and Miss Bradley has collected a great deal of evidence on the matter. Lennard has criticized her work[23] and has concluded that the evidence of the proponents of the theory is faulty and inconsistent. He has collected more data which can be reliably tested and states that "it is quite unscientific to conclude that the open field farms did decline in fertility in the fourteenth and fifteenth centuries." In support of the statement, he cites the evidence of the Rothampstead experiments in continuous cropping, which show that a minimum return is reached in a few decades and can be maintained almost indefinitely. But is not this very result a consequence of decline in soil fertility? Certainly Russia, no matter how unsatisfactory and uneconomic her agriculture, shows no clear indication of a decrease in soil fertility through centuries of cultivation by antiquated methods. Indeed, we find Durand stating clearly that density of population is the principal evil in eastern Europe, the main trouble with agriculture being due to inadequate plowing, unsatisfactory rotation, and the ownership of scattered, miniature patches and strips of land, no redistribution having taken place since the seizure of the large estates. The open fields still persist but in full peasant ownership.[24]

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[21] Gilbert Slater: The Inclosure of Common Fields Considered Geographically, *Geogr. Journ.*, Vol. 29, 1907, pp. 35–55.

M. Aurousseau: The Arrangement of Rural Populations, *Geogr. Rev.*, Vol. 10, 1920, pp. 223–240; reference on pp. 231–232.

Harold Peake, *op. cit.*, footnote 18, pp. 176–177.

[22] Sydney Herbert: The Fall of Feudalism in France, New York, 1921.

[23] Harold Peake, *op. cit.*, footnote 18, p. 155.

Harriett Bradley: The Enclosures in England: An Economic Reconstruction (Columbia Univ. Studies in Hist., Econ., and Public Law, Vol. 80, No. 2), New York, 1918.

Reginald Lennard: The Alleged Exhaustion of the Soil in Medieval England, *Econ. Journ.*, Vol. 32, 1922, pp. 12–27.

The explanation appears to lie rather in what Peake implies in several passages: First, population increased in the townships faster than new lands were brought under cultivation; then it increased after no more lands could be brought under cultivation, as a certain proportion of the waste was essential in the economy of the community. The only solution was a complete change in the method of occupation. This was effected ultimately by enclosure.

Little appears to be known of the population of England in the eighteenth century. There was a contemporary controversy during the seventeenth century as to whether it was declining or increasing, and a general belief had been in existence since Tudor times that London was draining the provinces. London certainly increased greatly, in a large measure on account of improved sanitation. It can hardly be doubted that the country as a whole showed a marked increase of population.[25] It is unnecessary to comment on the expansion of the nineteenth century; but the rural decline of that time is of great interest here, having been markedly regional in character.[26] Roxby has investigated five registration districts and finds that the fluctuations of population during the century take their character according to well-marked geographical regions. Certain favored regions of lower status, like the Vale of Evesham and the Vale of Wisbeach (Cambridgeshire), showed a continuous and steady *increase*. The movement towards small holdings and subdivision has also been regional in character.

THE REGIONAL LIMITATION

It has been suggested above that there is a limit of capacity for occupation of the land of a region. This limit is more clearly shown by an examination of the rural arrangements than by any other means, the possibility of the extent of growth of the higher elements being practically unknown. That numerous towns have remained practically stationary in their population for long periods is certain; but the relation of town growth to the productivity of the region in these days of intense production and interdependence of regions, has not been studied.

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[24] E. D. Durand: Agriculture in Eastern Europe, *Quart. Journ. of Economics*, Vol. 36, 1922, pp. 169–196. Abstracted in the *Geogr. Rev.*, Vol. 12, 1922, pp. 489–490.

[25] M. Dorothy George: Some Causes of the Increase of Population in the Eighteenth Century as Illustrated by London, *Econ. Journ.*, Vol. 32, 1922, pp. 325–352.

[26] P. M. Roxby: Rural Depopulation in England during the Nineteenth Century, *The Nineteenth Century and After*, Vol. 71, 1912, pp. 174–190.

The limit of occupation is the limit of subdivision, so far as rural folk are concerned. The economists of Europe, who demand great increase of population as a first necessity for further progress, are apt to overlook the fact that Europe has been producing people for a very long time under methods of occupation which have been relatively stable. The limit of subdivision has been reached in some regions, and the only possible growth is the growth of the cities and conurbations through the expansion of industry. France appears to be in this condition. It means that France must become increasingly dependent on external regions for the support of her people, and it is questionable whether external regions will long continue to supply the outside world to the same extent as they do at present. They themselves are growing. On the rich alluvia, as in China, space economy is already operating. In India and Egypt the God of Waterwheels is still extending the arable limits, with the assistance of modern irrigation engineering; but on the Flemish lowlands it is hard to imagine any extension of the present occupation.

The evolution of Norse settlement in the Shetland and Orkney Islands illustrates the results of the system of subdivision very well. Norse society lived under its own laws and customs in these islands until the middle of the sixteenth century. In 1468 the islands passed on mortgage to the Scottish Crown—a tenure which remains to the present day. Passing north from the shores of Scapa Flow on the Mainland of Orkney, one sees arable patches of 200 to 400 acres in extent. These are the "townships" and mark the position and extent of the original Norse estates. The traditional inheritance was one of impartial subdivision, and the present-day result is an occupation of the township by four to twelve or more small farms. In aspect the old estate is now a group of small and irregular fields, sprinkled fairly evenly with clusters of low buildings. Every member of the family had rights in his ancestral property, and subdivision was carried on until it was no longer practicable.[27] This result is becoming evident on the Continent, and in those parts of England, like the Vales of Evesham and Wisbeach and the lowlands of Essex, where the method of occupation is taking on the character of that of the Low Countries. In eastern Europe, according to the statement of Durand given above, we find density of population to be a condition of aggravation. Without the temporary palliative of emigration it is hard to conceive what the present-day state of industrial Europe would have been. In pastoral England an increase of the agrarian effort is still possible, and considerable extension did take place in agriculture during the war.

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[27] J. S. Clouston: A Branch of the Family, *Blackwood's Mag.*, Vol. 207, 1920, pp. 516–528.

THE SOURCES OF INFORMATION

Geography has a great amount of delving to do in the history of the occupation of countries. As first assistants we may consult the archeologists, who are able to trace the origins of settlement.[28] For the earlier phases of occupation they are also the only available informants. Written history then takes up the thread and needs to be sifted carefully for every shred of quantitative information and reliable estimate it can give. If I read in the memoirs of Casanova that Ancona had a population of seven thousand in the early eighteenth century, a reliable recorder is giving me geographical information. Statements bearing on the climates of historic times are also likely to prove very useful. For the later periods of history the economists are able to point to valuable results. There is also a legal side to the matter, as old legal usages have exercised a considerable influence in the rate of breaking away from obsolete methods of occupying the land; and legal and church history will not be barren ground. The task of geography itself is to provide accurate regional information. Ultimately we may hope for fairly complete records for a few favored regions, which will be an index to the interactions of the group and its region.

Deductions may also be made from the behavior of primitive peoples of the present day, and anthropology and ethnology are likely to have the information ready at hand. In studying the development of towns the help even of psychology cannot be ignored, in order to understand the reasons for the inertia which, when obviously sensible and beneficial changes are desired, fails to bring them about.

THE COLLABORATIVE ATTACK

The geographical task I have outlined is a formidable one. It is no reflection on geography that there is so great a deficiency of knowledge in these matters but is rather a reflection of the stage of evolution of the science. It is noteworthy that nearly all the references quoted here are of comparatively recent date, while some of them are from out-of-the-way and unlikely sources. Successful attack on the task can be ensured only through the training of qualified men, of geographers of many shades, capable of meeting specialists in other branches of science on their own ground; by effective liaison with other lines of investigation; by the publication of geographical results intended to reach, say, the anthropologist, in an appropriate journal which he is sure to read. Reliable information must also be spread broadcast so that it will come into the hands of the people who will use it. For example, could not the Association of American Geographers, or some kindred body, compile a bibliography of the geography of population and place it in

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[12] Such works as William Page: The Origins and Forms of Hertfordshire Towns and Villages, *Archaeologia*, Vol. 69, 1917–18, pp. 47–60. London.

the hands of every town-planning organization in the world and so bring much of it into direct use?

Modern Tendencies

The modern city, engaged in varied and intensive production, exists because the place where it is located enables it to do what it is doing. It may import its raw material from the ends of the earth, whither it undoubtedly sends its finished products; but it is an expression, fundamentally, of a favored place. Capacity to do one thing enables it to do another, perhaps having little connection with the first or with the place. Take away certain regional endowments, however, and the city would vanish. Very often these endowments take the simple form of easy fuel and easy water supply, with easy ore in the second rank. The great modern city can seldom feed itself on its own region, and the surplus of food production which keeps it going is taking the modified form of uniform regional production for export. The great producing plains, especially, have ceased to indulge in the numerous minor activities of agriculture. They have handed over these duties to the towns and are doing things on the largest possible scale, often with a surprisingly small number of men. The world as a whole is reacting as a region. The major regions are showing a tendency to develop uniformity of production in the service of all who need, taking their own varied necessities in their turn from many other regions. We speak now of an overpopulated Europe. Somewhere, far ahead, is the prospect of an overpopulated world. Will the adjustment that small regions have had to make in the past be the index of revolutionary changes in the method of occupation of Europe and ultimately of the world?

Some Provisional Conclusions

Present-day geography is not in a position to make a useful and quantitative contribution to the population question. In this consideration of the matter endeavor has been made to state the case and to suggest the line of its investigation. The following provisional conclusions are advanced as a qualitative effort in the development of a working hypothesis.

1. The geographic problem is the provision of information concerning the occupation of the regions of the globe for immensely larger populations of the future.
2. The occupants of the geographic region are the major units of the world's population. They constitute the group, which is a functional section of society.
3. The group consists of recognizable elements which exist in the service of production and are to be distinguished according to their grade of production.
4. The elements of the group occupy the region in a characteristic manner, dependent upon its configuration, climate, geological nature, etc. Free, natural arrangement is an evolutionary result.

5. Consideration of arrangement suggests that the region has a limited capacity for occupation under a given method.
6. In past times groups have exceeded the limit of occupation and have adjusted themselves by revolutionary change of the method of occupation.
7. Overpopulation is the condition arising from the occupation of a region by a method no longer suitable to support the group.
8. The present trend indicates that the world as a whole is reacting towards population as one region.

ECONOMIC GEOGRAPHY OF THE COAL RESOURCES OF ASIATIC RUSSIA

By P. P. Goudkoff

[With separate map, Pl. V, facing p. 292]

The building of the Trans-Siberian railway wrought a transformation in the economic life of northern Asia. Population flowed in; agricultural development advanced on a large scale; Siberia began to export the products of forest and field. A wholly new era dawned in the mining industry: improved methods of extracting ores were put into practice, and the output of many mineral products leaped to figures hitherto undreamed of.

The World War, instead of retarding, served as a further stimulus to this progress. Indeed, at the outbreak of the Revolution Siberia and Turkestan seemed to be on the eve of a great epoch of prosperity. In 1917 the normal increase of population was being mightily augmented by a stream of refugees from Russia's western provinces. Work was well started on the construction of new railways. Notable movements were either under way or projected in the two foremost industries of Asiatic Russia, agriculture and mining.

Agricultural Development

In the field of agriculture investigations were being made with a view toward introducing the cultivation of the sugar beet into the province of Semipalatinsk and into the southern parts of the governments of Tomsk and Yenisei. Hitherto the principal beet sugar territory of the Russian Empire had been those western governments which were being overrun by the Germans and whence came refugees accustomed to the raising of this crop. Recently completed irrigation systems in Turkestan were expected to bring water to new cotton fields. The southern part of the Tobolsk government and the districts adjoining the railway between Omsk and Tomsk as well as along the Altai railway constituted a rapidly growing wheat country and gave promise of a brilliant future for the flour mills of this part of Siberia—mills which, under stable conditions, should count among the largest consumers of Siberian coal. Farther east, in the Amur province, new land was being opened up to crops; in the Maritime province successful attempts at rice cultivation had been made, and a further increase in flax sowing was looked for.

Mining and Metallurgy

In the field of mining and metallurgy, the construction of a large iron foundry in the southern part of the Tomsk government was begun, and the improvement of older works in the Minusinsk district and in the Irkutsk government and Transbaikalian province was projected. The opening of new silver, lead, zinc, and copper mines in the Kirgiz Steppes, West Altai, and Minusinsk regions seemed probable. Well on the way toward realization were plans for the re-establishment of the exploitation of numerous and rich silver-lead deposits in Transbaikalia and for the reconstruction of the ore-dressing mill connected with the Tetiukhe mine on the Pacific coast about 200 miles north of Vladivostok, the largest lead-zinc mine in all Russia. Both in the West Altai and in the mountains between the Tom and the upper course of the Yenisei, where quartz mining for gold had been carried on for over twenty years, the possibilities of further developments were far from exhausted. First steps toward the introduction of quartz mining into the northern part of the Yenisei government had been made only a few years before; and in the Far East, where gold was still being obtained almost exclusively through placer mining, lode-gold deposits unquestionably of no slight importance remained unexplored. Mechanical methods of placer mining were being proved a signal success in the Yenisei government, but their successful application had also been demonstrated in many parts of eastern Siberia. Furthermore, in this far eastern portion of Asiatic Russia, which has continuously yielded more than 75 per cent of the total output of Russian gold, some new and rich gold fields had been recently discovered.

Besides these industries, we should not neglect to mention the coming commercial utilization of the oil fields of Transcaspia, Turkestan, and Sakhalin; of the salt deposits and salt lakes and springs in Transcaspia and in the governments of Tomsk, Yenisei, Irkutsk and Transbaikalia province, and perhaps in the Yakutsk province; and finally of the so-called rare metal ores of Turkestan, Transbaikalia, and elsewhere.

The Demand for Coal

All of these contemplated industrial developments foreshadowed a rapidly augmenting demand for coal—a demand destined to become even more pressing with the completion and operation of over 4700 miles of projected railway lines, with the inevitable substitution on the river steamers of the use of coal for that of wood, and with the increase in the number and size of the Ural iron works which were becoming more and more dependent on Siberian coke. The coal deposits of Siberia, however, were more than capable of meeting these probable demands. Indeed, it was planned that by the year 1930 the annual output of the coal mines of western Siberia alone should be increased to ten and a half million tons as contrasted with one and a half million tons of 1917.

But even this latter figure, small as it may seem when compared with the estimated future output, is immense when compared with the annual output of the latter years of the last century (as low as thirty to forty thousand tons) and gives a criterion for estimating what had already been accomplished toward the industrial utilization of Siberian resources during the twenty years before the Revolution. Prior to 1900 the population of Siberia was sparse (less than eight and a half million in 1897), and there was almost no demand for Siberian coal either in Siberia itself or in European Russia. What need there was for fuel in Russia's great Asiatic domain was met by immense and widely distributed forests. After 1897 the Trans-Siberian railway itself created the first genuine demand for coal, a demand soon to be followed by the requirements of the industrial expansion that followed in the train of the railway.

With a demand for coal came the exploration of the resources available. Geologists and operators began to see clearly what they had little suspected before: that the coal reserves of Asiatic Russia were very considerable in amount and high in quality. A summary of data on Russian coal was made by the Russian Geological Committee for the Twelfth International Geological Congress at Toronto in 1913 and was published in Volume 3 of "The Coal Resources of the World."[1] More recent information has since then been acquired, and the summary referred to is now entirely out of date as a result of systematic explorations inaugurated by the Geological Committee in 1912 and of explorations carried out by mining companies. The former, in co-operation with a Commission of the Russian Academy of Sciences for the Investigation of the Natural Resources of Russia, produced a report in 1919[2] which differs widely from that made to the Toronto Congress. Since 1919, as exploration has gone forward, additional reports have been published by the Siberian[3] and Far Eastern Geological Committees;[4] and several significant papers on the Siberian coal industry have appeared in newly established Russian periodicals,[5] all of which throw fresh light not only on the coal resources but also on the geology and geography of Asiatic Russia as a whole.

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[1] The Coal Resources of the World: An Inquiry Made Upon the Initiative of the Executive Committee of the XII International Geological Congress, Canada, 1913, 3 vols., Toronto, 1913.

[2] The Natural Resources of Russia (Yestestvenniya Proizvoditelniya Sili Rossii), Vol. 4, No. 20, "Coal" (Publications of the Commission for the Investigation of the Natural Resources of Russia Associated with the Russian Academy of Sciences), Petrograd, 1919.

[3] Notably the following articles in *Bulletin of the Siberian Section of the Russian Geological Committee* (*Izvestiya Sibirskago Otdeleniya Geologicheskago Komiteta*) published in Tomsk: (1) N. N. Urvantsev: The Norilsk Coal-Bearing Basin, with 18 drawings and a geological map, Vol. 2, No. 1, 1921; (2) K. E. Gabuniya: The Kasyanovo-Grishevsk Coal Deposit of the Cheremkhovo Coal-Bearing Region, with 17 drawings, Vol. 2, No. 3, 1921; (3) M. K. Korovin: The Cheremkhovo Coal-Bearing Basin, with 11 plates of drawings and maps, Vol. 2, No. 4, 1922.

[4] E. E. Ahnert: What Has Been Done and What Remains To Be Done for the Geological Study of the Russian Far East and Its Mineral Resources, *Records of the Geological Committee of the Russian Far East* (*Materiali po Geologii i Poleznim Iskopaemim Dalnyago Vostoka*), No. 1, Vladivostok, 1920. See also "The Mining Industry and Mineral Resources of the Russian Far East" (Gornaya Promishlennost Russkago Dalnyago Vostoka), a report compiled by P. P. Goudkoff and P. I. Polevoi at the request of the Maritime Chamber of Commerce, Vladivostok, with a map of the mineral deposits of the Russian Far East, Vladivostok, 1921.

[5] B. I. Shlain: The Coal Industry of West Siberia, *Mining* (*Gornoe Delo*), Moscow, 1920; S. V. Obruchev: The Coals and Graphites of the Turukhansk Region, *Mining Journal* (*Gorni Jurnal*), Nos. 3–5, 6–9, Moscow, 1922; I. I. Fedorovich: Prospects in the Coal Industry of West Siberia, *ibid.*, Nos. 3–5, Moscow, 1922; V. A. Obruchev: The Natural Resources of Russia and their Utilization, *Bull. Moscow Mining Academy* (*Vestniki Moskowskoi Gornoi Akademii*), Vol. 1, No. 1, 1922, pp. 3–13. See also A. Gapéev: On the Question of the Ekibastuz and Priirtish Coal Deposits, *Materials of General and Applied Geology* (*Materiali po Obshchei i Prikladnoi Geologii*), No. 44, Petrograd, 1920 (with two plates).

In view of the immensely important part which the coal deposits will play in the economic regeneration of Russia which is bound to come and which we may assume will follow, in a general way at least, the channels already marked out at the outbreak of the Revolution, it seems worth while to discuss briefly each of the individual coal basins and to indicate something of their economic and geographic relationships. We may divide these basins into two main groups. In the first are those which are best known and situated most advantageously in respect to present centers of population and lines of communication. In the second category are the deposits which have been less thoroughly explored, are less favorably situated geographically, and whose probable future importance we may only estimate in a very general way. To the first group belong the basins of Kuznetsk, Irkutsk, Minusinsk, the Kirgiz Steppes, Sakhalin Island, and the Maritime province, as well as the less rich deposits of Turkestan and the brown coals of the Yenisei government. In the second group fall the coal fields of the Amur and Transbaikalian provinces and of the Tungusk basin and the deposits of the Yakutsk and Kamchatka provinces.

On the accompanying map (Pl. V, facing p. 292), the larger basins and fields are shown in black[6]; separate deposits of lesser area and known crops are indicated by crosses.

Coal Basins and Fields of Primary Importance at the Present Time

1. The Kuznetsk Basin and Gorlovo Field

The coal reserves of this basin, which covers over 8600 square miles, are said to represent more than 50 per cent of the total reserves of Russia. Only within the last decade has their full significance been appreciated. The coals are of all kinds and of high quality. Mining was first developed in the northern part of the area in 1898, when the western section of the Trans-Siberian railway was opened. The demand for fuel by the railway led to a rapidly mounting output from the mines, which in the years between 1910 and 1917 increased over tenfold, or from 88,710 to 1,237,800 metric tons annually. It is estimated that in the near future the annual output, in so far as it depends on the reserves of coal prepared for mining, may well reach ten million tons. This would not only satisfy the demand for fuel in western Siberia expected to prevail in 1930 as a result of the increase of population, the construction of many miles of railways now contemplated, the transition on the river steamboats of the Tom, Ob, and Irtysh from wood to coal burning, and the development of the local metallurgical industries, but it would also make possible the realization of a project for the construction of three large iron works in the Ural to be operated with Kuznetsk coke. In this connection, the total quantity of fuel which will have to be transported to western Siberia and the Ural region will probably amount to as much as 13 million tons, about 75 per cent of which must be furnished by the Kuznetsk basin.

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[6] The coal deposits as shown on this map are based upon: (1) a map annexed to "The Natural Resources of Russia," Vol. 4, No. 10, "Gold" (see above, footnote 2); (2) a map in "The Mining Industry and Mineral Resources of the Russian Far East" (see above, footnote 4); (3) S. V. Obruchev: The Tungusk Basin, *Ore Bulletin* (*Rudni Vestnik*), Moscow, 1918, No. 4. The density of population is adapted from "Atlas of Asiatic Russia" (Atlas Aziatskoi Rossii), edited by the Department of Immigration, Ministry of Territorial Organization and Agriculture, St. Petersburg, 1914, map No. 26.

Between 1913 and 1917 geological explorations and prospecting were conducted throughout the basin by the Kuznetsk Coal Mining Company. The construction of a railway, which is to run through the basin from north to south, was completed in 1919 to a point about 52 miles northwest of the town of Kuznetsk.

West of the Kuznetsk basin lies the so-called Gorlovo anthracite field, occupying an area some 43 miles long by 6 miles wide. The reserves of the northern part alone are calculated at 3.8 million tons, but, owing to unfavorable geological conditions, this field is as yet undeveloped.

2. The Irkutsk Basin

This basin occupies an area of 17,200 square miles, or nearly twice that of the Kuznetsk fields. Over 32 million tons have already been prepared for mining by means of excavators. For the most part the deposits consist of bituminous coking coals; but at some places a transition into brown coal is known to occur, and resinous coals are found in other localities.

Here it was that coal mining on a large scale was first conducted in Siberia. The Irkutsk basin has supplied fuel for the Transbaikalian and Amur railways, and coal has been shipped from it westward as far as Taiga (southeast of Tomsk) and occasionally even to the Ural mountains. The output has ranged as high as fifty per cent of that of all the Siberian coal mines (1,237,800 tons in 1917). Future development is guaranteed by geological conditions exceptionally favorable to mining, by an advantageous position along the railway for a distance of over 300 miles, and by the absence of sufficiently developed mines in the Transbaikalian and Amur provinces. If the production of coke is found possible, the future of the region will be even brighter. Furthermore, in connection with the projected enlargement of the Ural metallurgical industry referred to above, it has been estimated that by 1930 no less than 2.42 million tons of Irkutsk coal may be transported annually in a westward direction.

3. The Minusinsk Basin

The coal-bearing formations near Minusinsk cover an area of 215 square miles and include both bituminous coking coals and sub-bituminous coal, of a quality on the whole somewhat inferior to that of the Kuznetsk coals though superior to that of the Irkutsk fields. The total output before the revolution was very limited in comparison with the output of the Kuznetsk basin, being 21,000 tons in 1914 and 40,000 in 1917. Future development depends upon the improvement of means of communication. The Achinsk-

Minusinsk railway, which will connect the coal fields with the Trans-Siberian line, is as yet unfinished, for, although the roadbed, stations, and many of the bridges have been constructed, rails have been laid only to a point some 30 miles south of Achinsk. The line Minusinsk-Kuznetsk-Barnaul, which will also link up the basin with the Trans-Siberian and South Siberian roads, is as yet merely a project. Much may be expected from the completion of these routes, as well as from the increase of steam navigation on the Yenisei and from the exploitation of the rich iron and copper ore deposits of the southern part of the Minusinsk district. Broadly speaking, it is expected that 350,000 tons of Minusinsk coal will be sent annually to western Siberia for use as fuel.

4. The Kirgiz Steppes

The deposits of the Kirgiz Steppes consist of anthracites, coking coals, dry coals, and brown coals—all of relatively inferior quality. The total output mounted from 27,666 tons in 1914 to 98,050 in 1917. Slow advance in the industry has been largely the result of inadequate means of communication. The portion of the South Siberian railway west of Semipalatinsk was not begun until 1917. Though the deposits are neither large nor of high quality, they are of great local value on account of the absence of any other fuel in the region. Lack of adequate communications has also been a serious handicap to the exploitation of the numerous copper, silver-lead, and zinc deposits of the Steppes, as well as to the progress of steam navigation on the Irtysh.

5. Sakhalin Island

The Sakhalin fields are the best of all deposits immediately adjacent to the Pacific. They include an abundance of high-quality bituminous and coking coals and more or less lignite. Development has been seriously retarded by the absence of good harbors for the protection of loading vessels from the stormy waters of the Gulf of Tartary.

6. The Maritime Province

Coal-bearing Jurassic rocks and lignite-bearing Tertiary deposits are widely distributed in the southern part of this province north and south of Vladivostok and for a long distance along the coast. The Jurassic coals are mainly anthracites and semi-anthracites, but coking coals and some other kinds also exist. Most of the coal is of rather low quality, though the lignites furnish a good fuel and in some deposits are very rich in volatile matter. The total production (including lignite) in 1917 was 584,800 tons. Inasmuch as a very considerable part of the coal-producing area is still unexplored, the real reserves may be greater than the estimated figures. A large increase in mining in this region is to be expected coincidently with the growth of sea and river fleets, the construction of railways, and the probable future development of the metallurgical industries on a more extensive scale.

The brown coals of the Maritime province are rich in volatile matter: it is thought likely that they will be utilized for obtaining distillation products such as paraffin, benzine, creosote, etc.

7. The Brown Coal Fields of Yenisei Government

Several basins of rather large size constitute these fields. Some of the seams are rich in volatile matter which renders possible their use in the production of paraffin and other similar substances. Good domestic fuel can also be obtained from them. In the years 1917–1918 only a few small mines were in operation in this district.

8. Turkestan

The fields of Turkestan contain anthracite, coking, and non-coking coals, but of these only the coking and non-coking coals are of practical importance. On account of their low calorific power and the unfavorable conditions of stratification in which they occur, the latter have come into use only after the almost complete exhaustion of wood for fuel.

Coal Basins and Fields of Secondary Importance at the Present Time

9. The Amur Province

Four fields of bituminous coal and one rather large basin of brown coal (about 215 square miles) are known in the Amur province. Shortage of fuel needed for the Amur railway and the impending change from the use of wood to that of coal on the large fleet of steamers on the Amur River will in all probability stimulate their development. A contributary incentive may well be provided by the exploitation of the very promising iron-ore deposits in the vicinity of the Little Khingan range. Means of communication, however, must first be improved.

10. Transbaikalian Province

The coals of the Transbaikalian province are found in separate and very small basins which contain beds of brown coal. Mining has been carried on only in two fields and there on a small scale. The most promising fields are those which lie near the town of Chita, where mining by excavators is possible, and the Bukachachi field, which, alone in the entire region, produces coal of high calorific power. On the whole it is to be expected that the coal industry of Transbaikalia will remain of limited and exclusively local importance.

11. The Tungusk Basin

According to S. V. Obruchev, the numerous coal deposits that have long been known in the region between the Yenisei and the Lena must be considered as belonging to one immense continuous basin occupying an area of as much as 387,000 square miles. The boundaries of this basin, as shown on the accompanying map, are drawn from Obruchev's data. The coals are both anthracite and bituminous, the latter in some localities grading into lignite. Near numerous trap intrusions the coals have been transformed into graphites which form at some places deposits of very considerable extent and of high quality. Information at hand regarding this great basin is very scanty; in fact it is impossible at the present time even to estimate the reserves of the greater part.

12. Yakutsk Province

Coal beds are known to exist at numerous points along the Lena north of Bestia station (60 miles below Yakutsk) and at various places in the valleys of the Vilyui, Olekma, Aldan, Indigirka, and Kolima River systems. The beds of the Vilyui valley are perhaps a continuation of those of the Tungusk basin. The deposits of first potential value are probably those on the right bank of the Lena sixty miles above the mouth of the Vilyui near Jigansk.

13. Kamchatka Province

Although coal is found at many places in the extreme northeast of Siberia and formations in which it occurs are widely distributed throughout vast tracts, the deposits of this remote quarter still remain almost totally unexplored. It is quite impossible to estimate their reserves even approximately, though it seems likely that bituminous coal and lignite are present in no inconsiderable quantities. The economic importance of these fields will depend on the use that may be made of them as a supply of fuel for the merchant marine and on the exploitation of gold placers known to exist along the coast of the Okhotsk Sea and in the Chukotsk Peninsula.

Total Resources of the Siberian Fields

Table I is a summary of the total coal resources of the various fields just discussed and of the total reserves of Siberia. "Actual reserves" are calculated on the basis of positive knowledge regarding the actual thickness and extent of the beds; in the case of "probable reserves" only an approximate estimate can be arrived at; and "possible reserves" are those where no estimate in figures can be given. No account of the category "possible reserves" was taken in adding up the grand total. The figure, consequently, is conservative.

According to "The Coal Resources of the World" referred to above, the total coal reserves of the globe were estimated as follows, in million tons:

Oceania	170,410	North America	5,073,431
Asia	1,279,586	South America	32,097
Africa	57,839	Europe	784,190

Of these total reserves of 7,397,553 million tons those of Siberia were given as 173,879 million tons, which is considerably less than half the figure which can now be given. The resources of Asiatic Russia (over 400,000 million tons) consequently represent a quarter of the total reserves of Asia and are one and a half times greater than those of Oceania, South America, and Africa put together. Nor is it at all unlikely that future explorations in the Tungusk basin, Maritime province and the far northeast may bring to light resources whose amount is unsuspected at the present day.

Future Development

The Revolution called a halt to the industrial operations which created a demand for these coals. Siberia and Russia during the last five years have together gone through a period of economic setback. Recovery will come through the return to political and social tranquillity and through the re-establishment and increase of exports. In northern Asia Russia will find her most abundant treasure of raw materials for export. As compared with European Russia these resources are almost virgin. But they are also to a very large extent ready for exploitation, and many are very favorably situated in relation to lines of communication by rail, river, or ocean. Hitherto Russia has neglected her Siberian resources perforce, by reason of the scarcity of population in Siberia and the lack of labor which this scarcity entails. Refugees from the war and famine zones, however, have tended materially to make good this lack; and there is no reason why, when conditions are ripe for the resumption of industrial activity, there should not be available an ample personnel to carry forward this activity on an even broader scale than was the promise of 1917.

The most extensive industrial growth may be looked for in the southern and western portions of Asiatic Russia. As one advances eastward there is a progressive diminution in the magnitude of probable developments until, in the far east, one reaches a region where all projects for a long time to come will be confined to the Pacific coast and to the neighborhood of the larger rivers. The distribution of population in the case of Asiatic Russia is a fair index of economic potentialities, and the accompanying map shows how markedly the density of settlement (1911) falls off to the north and east.

The geographical distribution of the coal resources likewise coincides with the regions of probable maximum industrial progress and increase of population. The construction of the Trans-Siberian railway resulted in the acquisition of knowledge of the coal deposits along its route and in their exploitation at a relatively early period. But the presence of the railway accounts only in part for the fact that the known coal deposits shown on our map appear to be predominant in southern Siberia close to the line. Though coals are found widely throughout Asiatic Russia, it is also likely that future exploration will serve to confirm us in our present belief that the southern and central belts are the areas where most coal will be obtained. But even were this not so, the largest basins known at the

Table I—Coal Resources of Asiatic Russia—(*In metric tons*)

	Actual	Probable	Total
1. Kuznetsk basin and Gorlovo field . . .	1,125,000,000*b*(*a*)	248,875,000,000*b*(*a*) 3,800,000*a*	250,000,000,000*b*(*a*) 3,800,000*a* 250,003,800,000*b*(*a*)
2. Irkutsk basin . . .	1,040,000,000*b*	148,960,000,000*b*(*l*)	150,000,000,000*b*(*l*)
3. Minusinsk basin . .	72,500,000*b*	800,000,000*b*	872,500,000*b*
4. Kirgiz Steppes . .		1,100,000,000*b*	1,100,000,000*b*
5. Sakhalin Island . . .	255,000,000*b*	1,745,000,000*b* 2,000,000*l*	2,000,000,000*b* 2,000,000*l* 2,002,000,000*b*(*l*)
6. Maritime province .	4,800,000*a* 18,230,000*b* 32,000,000*l*	46,970,000*a*-*b* 168,000,000*l*	70,000,000*a*-*b* 200,000,000*l* 270,000,000*a*-*b*-*l*
7. Brown coal fields of Yenisei government		2,050,000*l*	2,050,000*l*
8. Turkestan		170,000,000*b*	170,000,000*b*
Total reserves in the basins of primary importance . . .	3,280,730,000*b*(*al*) 4,800,000*a* 32,000,000*l* 3,317,530,000	400,926,970,000*b*(*al*) 3,800,000*a* 172,050,000*l* 401,102,820,000	404,207,700,000*b*(*al*) 8,600,000*a* 204,050,000*l* 404,420,350,000*b*(*al*)
9. Amur province . . .	1,380,000*b*	5,000,000*b* 625,000,000*l*	6,380,000*b* 625,000,000*l* 631,380,000*l*(*b*)
10. Transbaikalian province	30,000,000*l*	170,000,000*l*	200,000,000*l*-*b*
11. Tungusk basin . . .	32,030,000*b*(*a*)	40,500,000*b*(*a*) 32,000,000*a*	72,530,000*b*(*a*) 32,000,000*a* 104,530,000*b*-*a*
12. Yakutsk province		650,000*b*	650,000*b*
13. Kamchatka province	Very considerable possible reserves of bituminous coals and considerable reserves of lignites		
Total reserves in the basins of secondary importance . . .	33,410,000*b*(*a*) 30,000,000*l* 63,410,000	46,150,000*b*(*a*) 32,000,000*a* 795,000,000*l* 873,150,000	79,560,000*b*(*a*) 32,000,000*a* 825,000,000*l* 936,560,000 -*b*-*a*

Grand total in all the basins of Asiatic Russia Over 405,000,000,000

a, anthracite. *b*, bituminous. *l*, lignite. *b*(*a*), bituminous including a minor part of anthracite. *b*(*l*), bituminous including a minor part of lignite. *b*-*a*, bituminous and anthracite in unknown quantitative relations.

present time, those of Kuznetsk and Irkutsk, are so favorably situated that even without any assistance from other fields the former can satisfy for a long period every possible demand for coal from southwestern Siberia and the latter can do the same in respect to southeastern Siberia. The Sakhalin basin, almost unique among the coal fields of the Pacific coasts by reason of the high quality of its output, seems especially designed by nature for the export trade, and it is probable that the southern Ussuri region (Maritime province) may participate in this export. The successful maintenance of commercial connections with northern Siberia through the Kara Sea seems assured by the discovery of good coal near the source of the Pyasina River and by the probability of equally valuable coal deposits throughout the immense areas of the Tungusk basin which are as yet virtually unexplored. Finally, adding to these circumstances the fact that numerous deposits are known to exist within the province of Yakutsk, we may conclude that industrial development in so far as it depends on coal supplies is possible in any part of Siberia and that, however rapidly the demand for coal in Siberia and even in European Russia may grow, Asiatic Russia will long be in a position to meet this demand.

AMERICAN GEOGRAPHICAL SOCIETY

Meetings of January and February. The annual meeting of the American Geographical Society was held January 23, at the Engineering Societies' Building, 29 West Thirty-ninth Street. After the reading of the annual reports the Society was addressed by the Rev. Hugh Birckhead, D.D., on "Palestine, the Shrine of the Three Great World Religions." At the regular monthly meeting held on February 20 the Charles P. Daly Medal of the Society was presented to Major-General A. W. Greely. After the ceremony Captain Kilroy Harris delivered a lecture entitled "Through Unknown Australia."

Elections to Fellowship. At the November, December, January, and February meetings of the Society, President Greenough presiding, there were presented with the approval of the Council the names of 527 candidates who were duly elected as Fellows of the Society.

Presentation of the Charles P. Daly Medal to Major-General A. W. Greely. The Charles P. Daly Medal of the American Geographical Society was presented to Major-General A. W. Greely at the February meeting of the Society. In presenting the medal President Greenough spoke as follows:

"It is my pleasing duty tonight as your representative to present your Gold Medal to one of our own countrymen. The inscription attempts to condense in thirty words the results of a long and successful career. It reads as follows:

ADOLPHUS WASHINGTON GREELY
1922
He commanded an Arctic expedition
the results of which are among the
imperishable records of polar discovery
and he subsequently rendered
distinguished public service as Chief of the
United States Signal Corps

"Even with larger space allotted to me it is difficult to summarize suitably the notable attainments of our guest in the diversified fields of soldier, explorer, scientist, and writer; but I may attempt it briefly. In our Civil War his almost unique advance from private soldier to Brigadier-General was the prelude to continuous military employment until retirement by seniority in 1908 as Major-General. The interval gave opportunity for important service in Cuba, Porto Rico, China, and the Philippines, besides memorable humanitarian work as head of the relief service at the San Francisco earthquake. The Arctic Expedition of 1881 under his command reached farthest north at that period (83° 24′) and added new areas of land and sea to the map, reaching home after enduring almost unprecedented hardship and losses. Scientifically, the Lady Franklin Bay Expedition contributed many valuable researches. It made the nearest gravity observations to the pole, ascertained the climatic conditions of Grinnell Land, determined the hitherto unknown secular magnetic variation of that region, made glaciological studies, and through its tidal observations first disclosed the conformity of the sidereal day with the diurnal inequality of the tidal waves of the earth. The geographical discoveries included the interior of Grinnell Land, the shores of the western polar sea, and the extension of Greenland to within fifteen miles of its extreme northern latitude.

"Even a partial recapitulation of his published volumes attests alike the value and variety of his literary work. I may mention a part, namely: 'Proceedings of the Lady Franklin Bay Expedition' (1888), 'Three Years of Arctic Service' (1885), 'American Explorers and Travelers' (1894), 'Handbook of Polar Discoveries' (1896), 'Handbook of Alaska' (1912), 'Isothermal Lines of the United States' (1881), 'Rainfall of Western States and Territories' (1888), 'American Weather' (1888), 'Climatology of Arid Regions' (1891); and there are many others.

"In its recognition of the accomplishments that I have indicated our Society has honored itself and has added a worthy companion to the existing holders of our medal, which include the names of Peary, Amundsen, Stefansson, Younghusband, Penck, Brooks, Chisholm, and others equally distinguished.

"And now, Sir, in behalf of the American Geographical Society I ask your acceptance of this memento of its appreciation and good wishes together with the expression of its pleasure in thus associating its reputation with your own."

In accepting the medal and in replying to the address of presentation, General Greely referred to his first lecture before the Society upon the return of his expedition many years ago and made happy allusion to the pioneering and exploring instinct of the American people. He referred also to the international co-operation which was required to make the simultaneous meteorological records in which his expedition participated. He stated that the greater part of the meteorological records had never been worked up and that when this task was accomplished it would be found to contribute to an important degree to our knowledge of Arctic climate.

Award of the Cullum Geographical Medal to Edward A. Reeves. The American Geographical Society announces the award of its Cullum Geographical Medal to Edward A. Reeves, of the Royal Geographical Society, London. The medal bears the inscription:

EDWARD A. REEVES
1922
In honor of his substantial achievements
in geographical surveying.
By devising and improving instruments and methods
he created new standards
in the field of scientific exploration

Mr. Reeves has been connected with the Royal Geographical Society for over fifty years, the last twenty of which he has been in charge of the Course of Instruction in Practical Astronomy, Surveying, and Map Construction. He has written several books and numerous articles in the sphere of his work, including "Maps and Map-making" (1910) and "Surveying: Past and Present" (1916), and he is editor of the Royal Geographical Society's "Hints to Travellers."

Award of the Charles P. Daly Medal to Ernest de K. Leffingwell. A third award of the Charles P. Daly Medal of the Society for 1922 has been made to Ernest de Koven Leffingwell, Arctic explorer and student of Arctic geography. The medal bears the inscription:

ERNEST DE K. LEFFINGWELL
1922
For producing the first
accurate chart of a part of the
Arctic coast of Alaska
and for sustained and original investigations
in Arctic physiography

During the years 1905–1915 Mr. Leffingwell spent six winters and nine summers in Arctic Alaska. The results of his arduous researches, prosecuted almost entirely unaided, have been published by the United States Geological Survey as *Professional Paper 109*, "The Canning River Region of Northern Alaska."

Annual Reports of the Society. At the annual meeting of the American Geographical Society, held on January 23 at the Engineering Societies' Building, 29 West Thirty-ninth Street, the annual reports of the Council, of the Treasurer, and of the Special Committee were read as follows:

REPORT OF THE COUNCIL

New York, January 23, 1923

To the Fellows of the Society:

The report of the Council for the past year necessarily summarizes activities of wide range in research and in the popular presentation of subjects of geographical interest, following the precedent of past years. It is noteworthy, however, that the list of publications is larger than ever before and the appreciation of the public and of professional geographers quite exceeds its customary expression. Its steady contributions to the permanent body of scientific knowledge, in our judgment, justify the claim that the Society is an agency of very substantial value to the community and to the nation. It aims, on the one hand, to maintain collections of the first order, and, on the other, to use these collections and the energies of its staff in such a way as each year to do pioneer work in the field of geographical investigation.

In continuation of the policy of maintaining the library as an instrument of research on the part of scholars and writers, special attention has been given to the completion of a large number of serial publications, to the purchase of books and maps to fill gaps in our general collections, and to bind unbound books and mount maps so as to bring the collection into first-class physical shape.

Additions to the library during the year comprise 1465 books, 879 pamphlets, 5822 periodicals, 3257 maps, 68 atlases. The collection now numbers 61,675 volumes of books and pamphlets and 57,228 atlases and maps.

In addition to visitors who are interested in exhibitional features, such as our collection of wall maps, etc., there now come to the institution a growing number of consultants of the highest class, persons engaged in serious research requiring a specialized library with collections essentially complete in the various branches of the subject. This number has rapidly increased in the past few years, or since the war, on account of the many changes that have taken place in the maps of the period and a corresponding increase in public interest in applied geography.

The regular monthly lectures have been unusually well attended and appreciated. The speakers have been as follows: Mr. Henry Lee Shuttleworth, I.C.S., Professor Albert Bushnell Hart, Professor A. V. Williams Jackson, Mr. Fred Payne Clatworthy, Honorable John W. Davis, Mr. Carl E. Akeley, Mr. Charles Upson Clark.

The following awards were made of the Gold Medals of the Society: The Charles P. Daly Medal to Lieutenant-Colonel Sir Francis Younghusband, to Major General Adolphus Washington Greely, and to Ernest de Koven Leffingwell, Esq.; the Cullum Geographical Medal to Edward A. Reeves, Esq. The distinguished services in recognition of which these awards were made are detailed in the current number of the *Geographical Review.*

The *Geographical Review* has been continued as a quarterly periodical. Publication in this form permits each number to cover a wide range of interest and makes possible a harmonious balance of contents. Each number contains several well-illustrated articles, many of a descriptive nature and dealing with travel and exploration—a great Chinese river, the little-known territory of eastern Bolivia, the heart of Africa, an island of Arctic Russia. Such articles not only make interesting reading but are important sources of information. Many are noticed in domestic and foreign publications. The article on Belgium's mandatory territory has, for instance, been abstracted at length in French and Belgian colonial publications. Other articles of wide appeal are offered as contributions towards the solution of such contemporary problems as that of population or political developments in various parts of the world. More technical articles, many of which deal with the physical bases of geography, are primarily intended for professional workers. Similar variety is maintained in the sections devoted to record and reviews.

In addition to certain books and maps, the titles of which are given in the list of publications for 1922, the Society has steadily advanced its program of work upon the geography of Hispanic America. There are now in hand in various stages of preparation twenty-one sheets of the Millionth Map of Hispanic America in addition to the La Paz sheet already published, and it is hoped to carry this great work through to completion in the course of the next seven years, or possibly a shorter period if additional funds are to be obtained. As a necessary part of the program there has been gathered together a great catalogue of about ten thousand titles of maps published in books and sheets. It is hoped to complete this work and to reproduce it in typewritten form in a limited number of copies so as to make it available in a half dozen centers of research. Wide interest has been displayed in the great atlas that the one hundred sheets of Hispanic America will constitute, and especially over the light that these maps and the information upon which they were based will shed on many questions of distribution and relationship not only in geography but in a number of cognate sciences. The Society has sought to interest its Councilors and members in a plan of subscription to the cost of this work whereby, through the payment of a thousand dollars, an individual may become the patron of a given sheet, which will then bear his name or the name of some institution or corporation whom he may designate.

The very considerable expense of the Hispanic American Research and of the Monograph Publications has been defrayed by donations from members of the Council, who, however, deprecate any further acknowledgment of their generous support.

The year has been marked by the publication of an exceptionally large number of books and maps of permanent value, covering a wide range of geographical interest. The following list supplies the main title of each publication and a brief characterization of it:

1. BERING'S VOYAGES: An Account of the Efforts of the Russians to Determine the Relation of Asia and America. By F. A. Golder. Vol. 1: The Log Books and Official Reports of the First and Second Expeditions, 1725–1730 and 1733–1742. With a chart of the second voyage. Vol. 2: G. W. Steller's Journal of His Sea Voyage from Kamchatka to America on the Second Expedition.

   (It was through the work of Bering's expeditions that the true position of a part of northwestern North America was first known.)

2. THE FACE OF THE EARTH AS SEEN FROM THE AIR: A Study in the Application of Airplane Photography to Geography. By Willis T. Lee.

   (Illustrated by 80 oblique and vertical photographs.)

3. THE RECESSION OF THE LAST ICE SHEET IN NEW ENGLAND. By Ernst Antevs.

   (The rate of retreat of the ice sheet from Hartford, Conn., to St. Johnsbury, Vt., as determined by a study of certain fresh-water clays.)

4. GEOGRAPHY OF THE CENTRAL ANDES. By Alan G. Ogilvie.

   (A regional geography of a part of the Andean realm to accompany the La Paz sheet of the Millionth Map of Hispanic America. Illustrated with 17 photographs and 2 colored maps.)

5. LEGENDARY ISLANDS OF THE ATLANTIC: A Study in Medieval Geography. By William H. Babcock.

   (A classic treatment of the age-old problem of Atlantis as well as other islands celebrated in legend.)

6. A SHORT ACCOUNT OF THE FIRST SETTLEMENT OF THE PROVINCES OF VIRGINIA, MARYLAND, NEW-YORK, NEW-JERSEY, AND PENNSYLVANIA, BY THE ENGLISH.

   (Reprint of a rare booklet of special value in a study of colonial boundaries.)

7. INDEX TO THE JOURNAL OF GEOGRAPHY, 1897–1921, including the Journal of School Geography, 1897–1901, and the Bulletin of the American Bureau of Geography, 1900–1901. By Arthur A. Brooks.

   (An instrument of study comparable to the Index to the former Bulletin of the Society published in 1918.)

8. LIST OF MAPS OF HISPANIC AMERICA. I. MAPS CONTAINED IN PERIODICAL PUBLICATIONS.

(Limited edition of typewritten copies bound in book form and to be followed by several volumes dealing with maps in books and sheets.)

9. A CATALOGUE OF GEOLOGICAL MAPS OF SOUTH AMERICA. By Henry B. Sullivan.

(A convenient index for physiographic study.)

10. MAP OF HISPANIC AMERICA, 1:1,000,000 (15.78 miles to 1 inch), Sheet South E–19. LA PAZ, Provisional Edition.

(Conforms to the international standard of the Millionth Map. In 22 color tints.)

11. MAP OF HISPANIC AMERICA, 1:6,000,000 (about 100 miles to 1 inch).

(Published in three sheets as a base map for representing geographical distributions.)

12. DISTRIBUTION OF POPULATION IN THE LA PAZ SHEET AREA, 1:2,000,000.

(Accompanies "Geography of the Central Andes." Shows population in nine grades of density.)

13. MAP OF THE LA PAZ SHEET AREA TO SHOW UTILIZATION OF THE LAND, 1:2,000,000.

(Accompanies "Geography of the Central Andes." It shows types of agriculture, including plantation cultivation, and the centers of chief mineral production of 1915, together with the location of the most important mines.)

14. MAP OF ALASKA. Published jointly with the Alaska Road Commission, War Department, scale 1:1,250,000, or about 20 miles to one inch.

(Bears five thousand place names; shows roads of every type, radio, telegraph and cable lines, post offices, national parks and forests, and the population of towns according to the census of 1920.)

15. MAP ILLUSTRATING THE RECESSION OF THE LAST ICE SHEET FROM NEW ENGLAND AND NEW YORK. By J. W. Goldthwait. Scale, 1:1,250,000.

(Accompanies Antevs' "The Recession of the Last Ice Sheet in New England." The successive positions of the ice border are shown in red overprint.)

16. CHART OF THE VOYAGE OF BERING AND CHIRIKOV IN THE "ST. PETER" AND THE "ST. PAUL" FROM KAMCHATKA TO THE ALASKAN COAST AND RETURN, 1741. By Captain E. P. Bertholf. Scale, 1:5,500,000.

(Accompanies "Bering's Voyages," Vol. 1. A modern reconstruction of the tracks of the two vessels of Bering's second expedition, based on the log books and other original records and adjusted to known physical conditions.)

Forthcoming Publications

1. SOILS AND VEGETATION OF AFRICA. By C. F. Marbut and H. L. Shantz.

(Available for distribution on April 20. Illustrated by maps of the soils, vegetation, land classification, and rainfall of Africa, and published jointly with the National Research Council.)

2. AIDS TO GEOGRAPHICAL RESEARCH: Bibliographies and Periodicals. By John Kirtland Wright.

(Designed as an aid to research and locating published materials on a given subject.)

3. GEOGRAPHICAL LORE OF THE TIME OF THE CRUSADES: The State of Geographical Knowledge and Tradition in Western Europe during the Twelfth and Early Thirteenth Centuries. By John Kirtland Wright.

(A study in the history of geography.)

4. NEW YORK WALK BOOK. By Messrs. Torrey, Place, and Dickinson.

(A description of the scenery about New York and the roads and trails that provide access to open places. The book is in the general style of Dr. Dickinson's booklet on Palisades Interstate Park.)

5. THE LAND SYSTEMS OF MEXICO. By George McC. McBride.

(An intensive study of the use of the land and its geographical relations.)

6. STUDIES IN THE CARTOGRAPHY OF THE NEW WORLD. By George E. Nunn.

(A technical study of certain geographical questions in the time of Columbus.)

7. Desert Trails of Atacama. By Isaiah Bowman.
(A field study of border settlements in the desert valleys and highlands of central-northern Chile and northwestern Argentina, illustrated with many photographs and maps.)

As a result of observations made in 1921 on the study trip referred to last year, supplemented by information from printed sources, Mr. W. L. G. Joerg, Editor of the Research Series, prepared a report on recent geographical work in Europe, which appeared in the July number of the *Geographical Review*. The status and present tendencies of modern geography in the twenty-two countries of Europe, excepting Russia, in which the science is represented are discussed in this report, and in the case of some countries, such as Spain and the Netherlands, about which little is generally known of this matter, a brief history of the development of the subject is given.

The sixth joint meeting of the Association of American Geographers and the Society was held at the home of the Society on April 28–29, 1922. The conference, which was well attended, included guests from several government departments and from foreign institutions.

The number of Fellows of the Society is 4145, of whom 408 are Life Fellows. In addition, the Society in recognition of special services to geographical science elected to Honorary and Corresponding memberships the following persons:

Honorary Members

Lieutenant-Colonel Sir Thomas Hungerford Holdich
Major-General A. W. Greely
Professor Lucien Gallois

Corresponding Members

Gunnar Andersson
Charles Raymond Beazley
José J. Bravo
James Henry Breasted
Jean Brunhes
Henry Chandler Cowles
Baron Gerard De Geer
Albert Demangeon
Guillaume Grandidier
David George Hogarth
Mark Jefferson
Curtis Fletcher Marbut
Olinto Marinelli
John Linton Myres
Charles Rabot
Sir Aurel Stein
Lieutenant-Colonel Jean Tilho
Frederick Jackson Turner
Robert DeCourcy Ward

The report of the Treasurer annexed hereto gives a condensed balance sheet and a summary of the general income and expenses of the Society. The work of the staff has been conducted with zeal and efficiency which deserve the highest commendation.

By order of the Council.

Philip W. Henry
Chairman

Report of the Treasurer for 1922

Receipts and Expenses

During the year there has been received from annual dues, interest on investments, and sales of publications	$67,128.23
There has been expended for salaries, house expenses, library, meetings, publications, postage, insurance, etc.	82,507.37
Balance carried to Capital Account	$15,379.14

Condensed Balance Sheet, December 31, 1922

Cash	$21,838.12	Capital Account, Balance	$875.32
Sundry balances	304.95	Annual dues paid in advance	3,240.00
		Sundry deposits and reserves	13,085.25
		Monograph Publication Fund, Balance	2,812.54
		Hispanic-American Research Fund, Balance	2,129.96
	$22,143.07		$22,143.07

HENRY PARISH
Treasurer

REPORT OF THE SPECIAL COMMITTEE

The Special Committee appointed December 21, 1922, to nominate and invite suitable persons to fill vacancies which will occur in the offices of the Society at the date of its annual meeting in January, 1923, respectfully report that they recommend the election of the following gentlemen to the offices designated:

		TERM TO EXPIRE IN
President	John Greenough	January, 1924
Vice-President	Philip W. Henry	January, 1926
Domestic Corresponding Secretary	W. Redmond Cross	January, 1926
Treasurer	Henry Parish	January, 1924
Councilors	Madison Grant Grenville Kane Franklin D. Roosevelt Paul Tuckerman Roland L. Redmond	January, 1926

Hamilton Fish Kean
W. Redmond Cross
H. Stuart Hotchkiss
} *Committee*

GEOGRAPHICAL RECORD

NORTH AMERICA

Growth of the Reindeer Industry in Alaska. The potentialities of a great reindeer industry in Arctic America envisaged by Mr. Stefansson (see the review of "The Northward Course of Empire" elsewhere in this number of the *Review*) have been amply demonstrated in the Alaskan portion of that region. It is little more than thirty years since the first reindeer were introduced into Alaska. Today an estimate of the herds places the number at 200,000 animals, while another 100,000 have been killed for food and clothing.

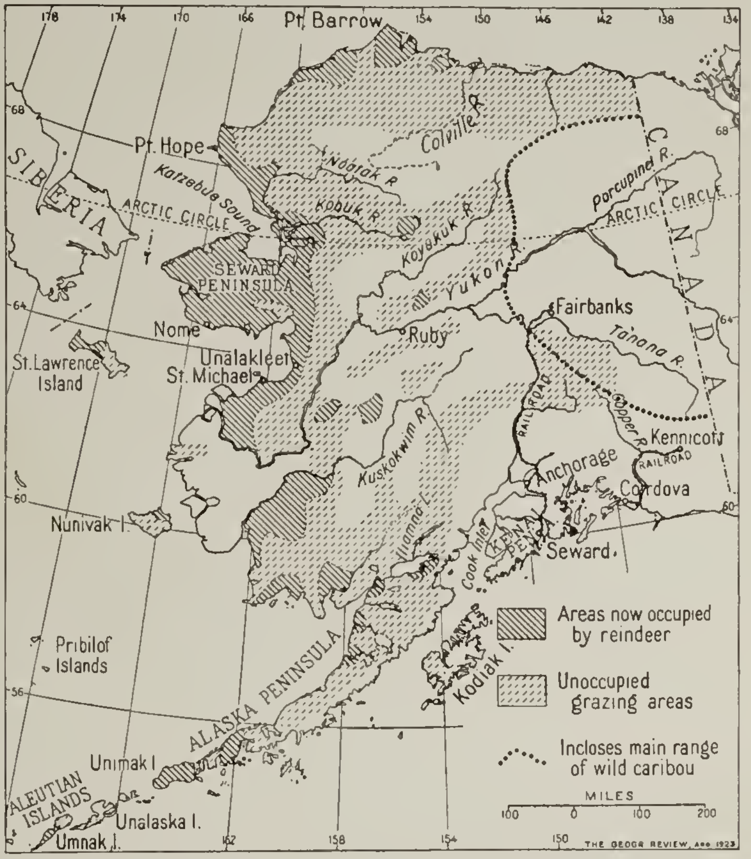

FIG. 1—Map showing reindeer grazing areas in Alaska, redrawn from the "preliminary" map on page 21 of Hadwen and Palmer's report.

Although transplanted so recently, the reindeer industry in Alaska shows considerable and increasing divergences from Old World forms (compare the article by K. B. Wiklund: The Lapps in Sweden, pp. 223–242). When introduced, the industry was intended solely for the benefit of the Eskimos; but in the natural course of events it has passed more and more into the hands of the whites. Already a quarter or more of the reindeer are under white ownership. The Eskimos were taught methods of reindeer management by Lapp herders whose methods in the first place were primarily adapted to conditions in northern Scandinavia and in the second place rested in a measure on old customs and superstitious beliefs. To put the industry on a commercial basis calls for the adoption of modern methods, and to this end the Biological Survey of the United States Department of Agriculture established in 1920 a reindeer experiment station at Unalakleet on the shores of Norton Sound (Seymour Hadwen and Lawrence J. Palmer: Reindeer in Alaska, *U.S. Dept. of Agric. Bull. No. 1089*, Washington, D.C., 1922).

The principles of handling stock in the Western States are generally applicable to herd management in Alaska. Unlike the close herding practiced by the Lapps, open herding similar to that of range cattle is preferred. In part because of the habits of the Eskimo and the existence of larger natural grazing units affording seasonal ranges, the tendency is towards the establishment of permanent ranches instead of the nomadic industry of the Mountain Lapps.

As a result of a preliminary survey it is estimated that there are 100,000 to 200,000 square miles of grazing lands available and that these are capable of supporting 3,000,000 to 4,000,000 reindeer. The grazing lands fall into two main classes: (1) the coastal areas and islands with summer grazing near the shore where salt can be obtained and comparative freedom from insect pests and (2) interior grounds with summer grazing on windy mountain tops. The best lands in the latter class are to be found at elevations between the timber line (2700 feet) and the snow line (6000 feet). At present, as may be seen from the map, grazing is confined almost entirely to the coast region. Extension into the far interior will be in part dependent upon improvement of transportation. A step in this direction is the railroad from Seward to Fairbanks.

The Progress of Mining in Canada. An outline of the history of Canadian mining was given by J. B. Tyrrell before the Boston meeting of the American Association for the Advancement of Science (*Science*, No. 1463, Vol. 57, 1923, Jan. 12, pp. 31–38).

The first mining venture in Canada took place in the later sixteenth century as a result of the reputed discovery by Martin Frobisher of gold on Baffin Island. Nothing, however, came of it; and the scene of the enterprise was not revisited for three centuries. It is interesting to note the possibility mentioned by Dr. Tyrrell that Frobisher's gold-bearing "black rock" may have belonged to the Keewatin or Pre-Cambrian Series now yielding such large quantities of gold in the Porcupine district of Ontario. In 1672 the occurrence of coal near Sydney, Cape Breton, is mentioned—the first record of coal on the American continent. In the succeeding two centuries many discoveries of minerals and ores were made at widely scattered localities throughout Canada, but actual production remained small until the new era of transportation commenced with the completion of the Canadian Pacific Railway in 1885.

In 1886, the first year for which an accurate statistical report on mineral production is available, the total mineral output barely exceeded $10,000,000. From this time, and notwithstanding the fluctuating production from some of the spectacular mineral discoveries, the quinquennial reports show steady increase in production. Discoveries following the systematic exploration of the Rocky Mountains region, begun by Dawson about this time, helped to a doubling of production in 1895. In 1900, as a result of the Klondike discoveries, production had risen to $64,000,000. The next decade saw the opening up of the Cobalt silver district, and production reached $106,800,000. This figure was more than doubled ($228,000,000) by 1920. It marks a large increase in the non-metallic products, especially coal, and the spectacular development of the Porcupine and Kirkland Lake gold deposits of northern Ontario. It is expected that the output of these mines for last year (1922) will amount to $21,000,000, and for the whole of Canada $27,000,000, making the Dominion the third gold-producing country of the world.

It seems likely enough that this remarkable progress will continue. Most of the mines now worked are situated in or not far from the confines of the southern border belt of Canada. Beyond that border belt, population is of the scarcest; and transportation is slow and imperfect. A vast new country still waits mineral exploration.

Peat Deposits of the United States. Investigations made during the war show a considerable increase in the estimated peat resources of the United States (E. K. Soper and C. C. Osbon: The Occurrence and Uses of Peat in the United States, *U. S. Geol. Survey Bull. 728*, Washington, D. C., 1922). The figure (exclusive of Alaska) is now placed at 13,827,000,000 tons of air-dried peat. The greater part of the deposits occur in the northern and northeastern part of the country, roughly within the area covered by the last ice sheet. Here ponds, marshes, and lakes of the drift-covered surface provide a suitable topography, and climatic conditions of relatively low temperatures and high humidity in the growing season also favor peat formation. The northern or "glacial" area is approximately defined on the west by the 20-inch line of annual rainfall—about the 97th meridian—and on the south by the July isotherm of 75° F. (see map on scale of 1: 7,000,000 accompanying the report). Ideal conditions prevail in the Great Lakes States, and here the bulk of the peat is to be found. Minnesota, Wisconsin, and Michigan together contain 10,335,000,000 tons, or nearly three quarters of the total resources of the country. The largest single deposit, covering 4000 square miles in Minnesota, lies in the basin of the ancient Lake Agassiz. New England, especially Maine and Massachusetts, contain many climbing bogs, in which the peat forms on flat or gently sloping moist areas as distinct from areas under water, and much sphagnum peat.

Apart from the Great Lakes region the largest areas of undrained lands are to be found along the Atlantic coastal plain and the Mississippi valley (cf. O. E. Baker: Land Utilization in the United States, in the January number of the *Review*). The latter region is unsuited to peat formation because of the amount of sediment carried by the water and the unequal distribution of rainfall throughout the year. On the other hand, the rainfall and humidity of the Atlantic seaboard are favorable; and deposits have formed in the drowned valleys and lagoons resulting from subsidence of the coastal plain and in the flat, imperfectly drained areas inland. The largest deposits occur in Virginia, North Carolina, and Florida, the last named state containing 2,000,000,000 tons of good-quality peat. Peat is also found in a narrow belt along the Gulf coast.

Routes to Desert Watering Places in the Southwest. Everyone interested in desert landscapes, in relief and vegetation, and in the distribution of desert life in general will be grateful for four admirable papers on routes to desert watering places in the Southwest ("Routes to Desert Watering Places in the Salton Sea Region, California," by John S. Brown; "Routes to Desert Watering Places in the Mohave Desert Region, California," by David G. Thompson; "Routes to Desert Watering Places in the Lower Gila Region, Arizona," by Clyde P. Ross; and "Routes to Desert Watering Places in the Papago Country, Arizona," by Kirk Bryan, *U. S. Geol. Survey Water-Supply Papers 490-A, 490-B, 490-C, and 490-D*, respectively, Washington, D. C., 1920–22. Mr. Thompson's report was reviewed by Prof. W. M. Davis in the *Geogr. Rev.*, Vol. 12, 1922, p. 155). Not the least valuable part of this enterprise of the Geological Survey is the striking series of maps accompanying the reports. When these maps are assembled they give one a vivid picture of a part of the real American desert in the Southwest which occupies on them a strip about 500 miles from southeast to northwest and about 250 miles from southwest to northeast. The maps embrace the Mohave Desert, the Salton Sea region, a part of the lower course of the Colorado River, and portions of the block-mountain type of relief characteristic of southern Nevada. They lie in those portions of the "basin-and-range" province designated by Fenneman as the Sonoran Desert and the Salton Trough (N. M. Fenneman: Physiographic Divisions of the United States, *Annals Assoc. Amer. Geogrs.*, Vol. 6, 1916, p. 42).

The maps display a wide range of desert relief. West and northwest of the Salton Sea are the broken slopes of the San Bernardino and subsidiary mountains. In the Mohave Desert region farther north are scattered hills and clusters of half-buried mountain ranges, while east of the Colorado the filling of the desert basins has been carried to the point where only the tops of the mountains protrude above a vast plain of waste. In form the mountains range from the irregular dissected slopes west of the Salton Sea to the well-defined block mountains lying at the eastern border of the Mohave Desert that continue the type of structure and relief characteristic of the mountains of Nevada. Again in the region east of the Colorado and immediately north of Mexico the burial of the mountains has gone so far that only the crest lines rise above the plain of waste. In addition, the blocks of this district, once with short, steep slopes on the one side and long and gentle slopes on the other, have now been eroded in many cases over so long a period of time that the two slopes have become nearly if not quite equal.

The relief shading upon the maps, which is one of their most useful features, has been done by John H. Renshawe, who has mastered the special technique required and produced a series of maps of which these are perhaps the most striking example. He has employed three tints that give hypsometric values with great clearness and fidelity. The lowest depressions are represented by the darkest shading, which is a reversal of the general scheme to which we have been accustomed. The slopes of the mountains above the desert plain are represented by a shade of brown distributed in the conventional way, with the light in the upper left-hand corner and broken, of course, to fit the relief of the mountains, which still further lightens the shade. The highest slopes and summits of the mountains are represented by the lightest of the three shades employed. The effect of Mr. Renshawe's treatment is happy in all respects. The general appearance of the relief closely resembles the appearance of the desert landscape just before sunset, when the shadows have gathered upon the plains and in the ravines on the eastern side and the summits and western slopes are yet in full sunlight. The resemblance to the sunset effect is all the more striking because in the desert the noonday sun sheds too bright a light for the desert forms to be clearly visible. They are overlighted, and relief effects largely disappear. In this respect overlighting in the desert conceals the relief to the degree to which haze conceals it in the humid air of our eastern mountains.

The present four papers are described as "abbreviated guides." Brief summaries of the physical features, settlements, roads, means of travel, forage, and the like, with suggestions to motorists respecting clothing, fuel, etc., are followed by road logs and short notes on the watering places. Reports giving detailed information on the watering places and comprehensive descriptions of the geography, geology, and hydrology of the region are in preparation. For the belt east of the Colorado River it is worth referring at this time to the cross sections, geological descriptions, and topographic analyses given in Willis T. Lee's report of 1908 (W. T. Lee: Geologic Reconnaissance of a Part of Western Arizona, *U. S. Geol. Survey Bull. 352*, Washington, D. C., 1908). For the vegetation and other matters of biological interest there is still no better report than the excellent one by Mearns to which reference may be made (E. A. Mearns; Mammals of the Mexican Boundary of the United States: A descriptive catalogue of the species of mammals occurring in that region, with a general summary of the natural history and a list of trees, *U. S. Natl. Museum Bull. 56, Part I*, Smithsonian Instn., Washington, D. C., 1907.) The maps accompanying the guides show all details regarding *water*—lakes, streams, wells, reservoirs, springs, etc. The conclusion of this great work ought to have an immediate effect, for the region is now accessible for tourists; and no doubt development also will be hastened, though the possibilities are very meager.

New Relief Maps by the U. S. Geological Survey. The Geological Survey is producing a series of extremely useful maps with the relief represented in three shades of brown. The shades are employed with a hypsometric effect, the lowest depressions having the darkest shade and the highest elevations the lightest shade. We have referred to this in the note above on the desert watering places of the Southwest. There the employment of the technique developed by John H. Renshawe could be made particularly effective because of the contrast between half-buried mountain and adjacent flat plain. One of the series is entitled "Relief Map, State of Ohio," scale 1:380,160, and over much of the area the relief is so slight as to furnish a severe test of this method of relief representation. The effect is as striking and the interpretation of the relief as faithful as in the case of the contrasting mountains and plains of the Southwest. The successive concentric terminal moraines with their closely associated sympathetic drainage lines southwest of Toledo constitute one of the most instructive features of the map. In great contrast to the trend and pattern of the drainage of northwestern Ohio as fashioned by the Erie lobe of the Wisconsin ice sheet is the drainage and relief of the central part of the state, where the preglacial topography is more strongly expressed. A little more than the eastern third of the state is included within the Appalachian plateaus, and here the effect of glaciation has been very slight as compared with its effect in northwestern Ohio. To bring out these three main divisions of the state within so narrow a range of relief is to have achieved a striking success.

The quality of relief shading is well shown on the Monument Spring quadrangle of Texas. The map was produced with brown contours; it was then shaded in a more nearly conventional way, with the light coming from the left or the upper left, all of the eastern slopes being represented with the darkest shade of brown. This left the mountain summits and the plains more nearly alike, with the mountain summits the lightest of all. The experiment was conducted in part as a means of helping the layman and the army officer, for example, to read the relief perhaps more readily than could be done from the contours alone. The shading on this quadrangle differs from that used upon the map of Ohio and the Mohave Desert by having no hypsometric gradations.

SOUTH AMERICA

A Vegetation Map of the Peruvian Andes. Dr. August Weberbauer has published a map of the vegetation of the Peruvian Andes between latitudes 4° 30′ and 17° S. and extending from the Pacific coast to the Amazon plain (*Petermanns Mitt.*, Vol. 68, 1922, pp. 89–91, 120–122, and map 13). The scale of the map (1:3,000,000) and the color scheme adopted permit of a rather detailed drawing of the outlines of the various formations, of which there are twenty-five; and narrow strips as well as isolated patches of less than ten square miles are clearly visible. The work is apparently based upon extensive exploration by the author as well as upon the researches of others, and, in addition to being of great value to students of regional botany, it is to be considered as an important contribution to the geography of South America. Not only does it enable us for the first time completely to visualize an important element in the landscape—the vegetation, but in a country where meteorological stations are few and far between we have before us an index to the varied climatic zones of Peru much more accurate than any hitherto available. Moreover, since the types of agriculture associated with each natural formation are known, this map brings us nearer, by a large step, to an adequate cultural map of Peru. We are led to hope that research along two lines will now proceed quickly and so render Dr. Weberbauer's work still more useful. The researches needed are botanical and cartographic. The first, by determining with precision the conditions of climate and soil needed by plants typical of each formation as well as the range of these, might advance climatic studies in an important measure; and there is little hope of an equal advance due to extensive meteorological study. The surveyor and cartographer can and will produce a much better map of Peru than the one upon which the present map is based and so permit of a redrawing of the vegetation—and other features—more accurately and on a larger scale.

The twenty-five formations of the author may be described in summary as follows:

1. *Algarroba groves;* including agricultural areas replacing them; hydrophilous; characterized by *Prosopis juliflora*, a prickly evergreen; occurring in the coastal desert valleys between 6° and 7° and between 14° and 15° with and without temporary herbaceous vegetation according as rain is rare or annual. [Cf. division between (5) and (6).]
2. *Mixed river-bank bushwood of the coastal zone*, including agricultural areas replacing it; hydrophilous; various trees, shrubs, and reeds, probably originally occupying narrow strips in the desert on all streams save those mentioned above.
3. *Desert;* in some places with isolated plants such as gray Tillandsias and lichens nourished by dew and mist; less frequent north of 11°, where moisture is rarer. Fifty kilometers are often passed without seeing a plant; from 6° 45′ this desert is broken only by stream-bank oases (1) and (2).
4. *Lomas vegetation;* of the Lomas, or coastal hills, between ocean and desert; xerophilous; nourished by the *garua* (coastal fog) alone; a mixed herbaceous vegetation consisting mainly of delicate, thin-twigged shrubs and some grasses. Southward from 10° 30′ it forms an almost continuous strip, the two chief gaps being at about 14° and 15° 30′.
5. *Scattered evergreen ground-water woods;* xerophilous; occupying the coastal zone north of the desert but best developed north of 6°. As the rainless period is often 20 years long, there is no herbaceous vegetation between the bushes and stunted trees of *Prosopis, Capparis, etc.*
6. Like (5); xerophilous, but with herbaceous vegetation between bushes, due to sparse summer rains; including also certain deciduous trees; occupying the higher ground inland from (5) north of 6° 30′.
7. *Open, mixed xerophilous vegetation;* of cactus, especially pillar varieties, and deciduous shrubs, but no trees; forming a continuous zone on the lowest western slopes of the Andes from 8° southward; its upper limit varying from 2500 m. in central Peru to 3600 m. in the south; found also in strips along some of the interior valleys.
8. Like (7); xerophilous, but with small deciduous trees (*Bombax*, etc.) and much grass; occupying interior valleys such as the upper Marañon and Apurimac; upper limit rising either southward or upstream in each locality, thus: on the Pacific slope (between 5° and 7° 30′), from 250 m. to 1800 m.; in the Marañon valley, from 1500 m. to 2300 m.; in the Mantaro valley, from 1800 m. to 2100 m.; in the Apurimac system, from 1800 m. to 2400 m. The increasing altitudinal limit of this xerophilous formation corresponds to decrease in moisture.
9. *Savanas;* macrothermal and xerophilous, rainy-green grass steppe with isolated deciduous trees and shrubs—closing to woods along streams—and very little cactus; in the valleys of the Mantaro and Apurimac (1600 to 1800 m.) and Urubamba at about 1500 m.
10. *Macrothermal deciduous* (*xerophilous*) *woods;* of bush and shrubs, including cactus, alternating with rainy-green grass steppe. The distribution of wood is independent of streams; occupies valleys of Marañon to 900 m. and of Quirós to 2000 m.
11. Like (10); xerophilous, but of woods seldom interrupted by steppes; cactus common; between 4° 50′ and 7° on the Pacific slope (900–1600 m.) and in valleys (1500–1800 m.).
12. *Transitional vegetation;* xerophilous and between macrothermal and mesothermal; consisting of rainy-green bushwood, often with much grass and in places interrupted by rainy-green steppe; narrow strips generally sandwiched between lower, drier formations and higher, moister formations (often between (8) and (19)); on the

Pacific slope between 7° and 8° and in the inter-Andean valleys south of 6° 40′. Its limits are from 1500–2400 m. (lower) to 2500–2900 m. (upper). The upper limit of tropical agriculture lies in this zone.

13. *Mesothermal rainy-green steppe;* with isolated (subxerophilous) shrubs (cactus absent); continuous on Pacific slope from 8° to 14° 30′ and in upper basins of the Marañon, Mantaro, and Apurimac; lower limit from 2500 m., rising southward to 3400 m.; upper limit 3800–4000 m.
14. *Mesothermal tola heath;* subxerophilous; characterized by the evergreen composite shrub *Lepidophyllum quadrangulare;* alternating with formations of other narrow-leafed shrubs and grass steppes with isolated shrubs; almost entirely on the Pacific slope from 14° south. Upper limit about 4000 m., lower limit varying from 3200 to 3700 m.
15. *Microthermal tola heath;* mixed with the high Andean (shrub-free) formation. Tola continues as in (14) up to 4200 m. but is accompanied by cushion-like plants instead of the mesothermal shrubs and corresponding agriculture.
16. *Typical high Andean formation* (*microthermal*)*;* cushion-and rosette-shaped plants; occasional squarrous shrubs; highest stature reached in occasional groups of *queñoa* (*Polylepis*)*;* covering the high plateaus in a belt narrowing gradually northward and terminating at 8° 20′.
17. *Microthermal grass steppe;* practically evergreen. Where not used for pasture and regularly burned, grass is very thick, as dead blades do not decompose quickly. Replaces (16) in moister situations and extends down to 3400 m.; forms a nearly continuous zone on the highest eastern slopes of the Andes and prolongs the central zone of (16) northward; northern limit about 6° 30′.
18. *Glaciers and permanent snow;* occupying relatively very small patches.
19. *Mesothermal transitional formation;* between those of subxerophilous and hygrophilous character; consisting of rainy-green grass steppe with much shrubwood partly evergreen; more shrubwood and more periodicity than in (13) but less than in (23);. occupying slopes in the interior basins of the Amazonian rivers between 2500–2800 m. and 3700–3900 m.
20. *Transitional formation;* between macro- and microthermal; consisting of bushwood partly evergreen, partly rainy-green, and interrupted by rainy-green grass steppe; no cactus; occurring in strips below (19) in the same valleys and at varying altitudes but more extensive north of 7° where it reaches the Pacific slope. It is similar in several ways to (12).
21. *Bushwood, macrothermal, subxerophilous, and evergreen;* alternating with evergreen grass steppe. Occurring in patches within the forest limits on eastern slopes of the Andes and in a wide stretch west of the Huallaga River between 6° and 7°; upper limit from 1500 to 2000 m. The reason for the existence of this formation, with some xerophilous characteristics and no large trees, is in doubt—perhaps to be explained by soil poverty.
22. Like (21), but uninterrupted by grass steppe; a small occurrence noted in the Marañon valley just south of 6°.
23. *Evergreen woodland of the cloudy zone—alternating with grass steppes;* hygrophilous and mesothermal. The woodland varies between shrubwood and bushwood including hardleaved shrubs and lichens, mosses, and epiphytes; seasonal rhythm evident chiefly in the grasses. Occurs in strips on the eastern slopes of the Andes, northward to 6°, crossing the Andes between 5° and 6° and thence northward on the Pacific slope; upper limit 3400–3900 m., lower limit usually 2400–2600 m.
24. *Evergreen forest of the cloudy zone;* practically uninterrupted by grass steppe; the *Ceja de la Montaña* (eyebrow of the forest); hygrophilous and mesothermal; characterized by hard-leafed trees and by lichens, mosses, and epiphytes; undergrowth dense; seasonal rhythm scarcely evident. Occurs as a continuous strip on the eastern slope throughout Peru and on the central Andes north of 6° 30′; upper limit 3400–3800 m., lower limit 1800–2300 m.; occurs also on summits of eastern foothills, where it reaches as low as 1200 m.
25. *Tropical rain forest;* hygrophilous and macrothermal; trees completely dominant. On account of the small amount of light penetrating the tree crowns the undergrowth away from rivers and clearings is thinner than in (24) and consists mostly of young trees and lianas.

AFRICA

Further Evidence on Desiccation in Northern Africa. A recent contribution to the desiccation theory of northern Africa (compare *Geogr. Rev.*, Vol. 11, 1921, pp. 622–623) is made by Mr. F. W. H. Migeod in the article "Some Notes on the Lake Chad Region in British Territory" (*Geogr. Journ.*, Vol. 60, 1922, pp. 347–359). Mr. Migeod expresses the opinion that not only is the zone of desiccation encroaching from the Sahara but that "the most alarming feature about it is the appalling rapidity of its advance." Various evidences of desiccation in the vicinity of Lake Chad—drying up of streams, of ponds and swamps, of wells, and of vegetation—are shortly discussed. The evidence of tribal movements is merely mentioned with the comments that "whenever a movement takes place, and a new village is founded, it is always to the south of its predecessor" and that each successive capital of the Bornu empire dating from six centuries back has been south of its predecessor.

Lake Chad itself is a salient into the drying zone, a protection to the fertile grain-growing lands behind. The vast swamp represents the drainage from two streams, the Shari from the south and the Yobe from the west. While there is no reason to believe that less water is brought down by the Shari, the Yobe, the greater part of whose basin lies in the zone of desiccation, has carried less and less water during the last thirty years. Coincidently there has been a general retreat of the lake shores.

A continuous process of desiccation in the lacustrine basin of the Niger above Timbuktu has been in progress since the middle of the last century. Colonel Mangeot, describing it in *L'Afrique Française* for December, 1922 (Le desséchement du bassin lacustre du Niger, pp. 524–526), expresses the opinion that the phenomenon is not due to diminution of rainfall at the sources of the river but is to be attributed to a cutting down of the rocky barriers which formerly ponded up the waters of the several lake basins.

The Drought Problem in South Africa. During 1918–1919 South Africa was visited by one of the worst droughts of recent years. The rainfall was less than in any year since 1903, and the losses to the farmers were extremely severe. Direct losses were estimated at not less than £16,000,000. The seriousness of the problem lies in the general trend towards desiccation whereby the situation during the recurring periods of drought is rendered increasingly precarious. This is emphatically stated by the Drought Investigation Commission which started work in 1920 and has lately published an interim report. (An outline of the report is given in the *Journ. Dept. of Agric.*, *Union of So. Africa*, Vol. 5, 1922, Pretoria, pp. 118–130.)

As a preliminary the Commission establishes two facts: first, that a large part of South Africa was dry long before the arrival of the white man; second, that since his arrival large areas show increased dryness—rivers, waterholes, etc., dried up—because of denudation of the vegetative cover. In this second fact lies the basis of the findings and recommendations of the Commission.

Declining rainfall as a cause of desiccation has long been argued, but the Commission finds no evidence of such decline during recent historic times. As to a possible change in the nature of the rainfall, the Commission does not commit itself though admitting that this is "within the bounds of possibility." On the contrary it is indisputable that the "economic value," or efficiency, of the rainfall has diminished. "The rains of last generation fell on unbroken, understocked grazing lands and were more lasting in their beneficial results than rains of equal magnitude falling today on veld overstocked, tramped out, semi-waterproof, hard-baked by sun and veld fires."

Destruction of the veld is in turn attributed to the present system of stock farming, the harmful features of which are cumulative in their effects. Especially harmful is the general practice of kraaling, or concentration of the stock at night, which necessitates much driving of the stock by day with increased food requirement and trampling of the veld, an evil further aggravated by the lack of adequate watering places and by overstocking. Kraaling is necessitated by the depredations of the jackal. An essential step in reform is extermination of the animal, and the best means towards this end is the use of jackal-proof fencing.

Erosion of the vegetative covering also has its effect on agriculture, especially in relation to irrigation. The increasing frequency of river floods demands the creation of expensive protective works and leads to the silting up of reservoirs. The Commission recommends the immediate appointment of a Reclamation Officer to deal with the problem of soil conservation.

Irrigation in South Africa. In a paper under this title appearing in the December (1922) number of the *South African Geographical Journal*, Mr. F. E. Kanthack discusses the place of irrigation in the economic development of the Union of South Africa. Rainfall conditions are such that irrigation is necessary for agriculture over the greater part of the Union. Over 12 per cent of the area the rainfall is less than 5 inches; over 33 per cent it is less than 10 inches; and over 65 per cent, less than 20 inches. Furthermore, distribution is unequal, little rain falling in the critical months, August, September, and October. It is estimated that 90 per cent of the Union requires irrigation during September and October. At the same time irrigation possibilities are limited. The run-off from the rivers is small (see also the article "Some Notes on Rainfall and Run-off in South Africa," by J. R. Sutton, in the same number of the *Journal*), really big floods are not frequent, and evaporation losses are high. Topographic conditions are also unfavorable to the development of irrigation schemes on a large scale. Good soils are confined to the alluvium of some of the river valleys; in fact, it is doubted whether as much as two per cent of the total area can be classed as good or fair from the culturable point of view. Omitting the coastal zones of the south and east with sufficient rainfall for most crops and the area with a mean rainfall of less than 10 inches where irrigation possibilities are exceedingly small, the total area of irrigated and irrigable land may be estimated at 3,000,000 acres. It is suggested that the most economical use of much of this land would be for the production of high-grade fodder to supplement the pastoral resources of the veld whose stock-carrying capacity is limited (see preceding note).

The Physical Geography of Portuguese Nyasaland. This section of Portuguese East Africa stretches eastward nearly 400 miles from the southern part of Lake Nyasa to the Indian Ocean, between latitude 11° and 14° S., and has an area of about 80,000 square miles, about one-fifth of the entire colony. It is one of the least known and apparently one of the least valuable of the African territories according to R. R. Walls, who describes it in an article in the *Scottish Geographical Magazine* (Vol. 38, 1922, pp. 164–181). His description is rather vivid, but the explanatory remarks regarding the forms of the land do not always inspire confidence.

A light sandy soil and a thick tropical vegetation cover most of the region. A coastal belt, about twenty miles wide, consists of uplifted marine deposits in the nature of raised beaches, including coral rock, calcareous sandstones, and unconsolidated muds, in horizontal layers lying unconformably on older rocks. These older rocks, emerging westward, occupy the rest of the region; they are for the most part highly metamorphic gneisses and schists, including a prodigious amount of iron ore, along with quartzites or banded jaspers; there are also occasional intrusive granites. The rocks appear to have suffered great regional thrusts from the south and the east; the latter movements are "of recent geological date and may . . . be still going on." It is implied that the north-south basin of Lake Nyasa is due to these later deformations. Sufficient value is not, in the reviewer's opinion, ascribed to denudation as an agency in giving the present form of the region.

The surface, which rises gradually from the coast to the border of Lake Nyasa, is generally of moderate or small relief; but "here and there mountains rise abruptly from the level sandy plain" to a height of several hundred feet. These mountains are all of the nature of Inselberge—and this alone would suggest that the surrounding surface has been much lowered by degradation—like "petrified whales in a sea of sand." They are of four kinds: (1) isolated bosses of intrusive granite; these are rather common although granite occupies but a small share of the total area; (2) mountains of steeply folded gneisses and schists, forming long ranges, parallel to the rock foliation; the ranges are seldom continuous, but usually consist of a "number of isolated humps in line with one another"—and as such they must almost certainly be the residuals of a long-continued period of erosion; (3) sharp escarpments of quartzite, mostly in the south; (4) boulder mountains: these are said to occur "where regional compression has taken place in two or more directions not in line with one another, and the rocks [their composition is not stated] have broken up into huge boulders piled on top of one another." This explanation seems very questionable: the boulder mountains are probably like the Matopos of Rhodesia, the result of long-continued weathering and far-advanced disintegration.

Almost the only reference to denudation as a cause of physiographic features is a brief statement to the effect that the country "owes much of its characters" to the weathering of the rocks. Disintegration under sunshine is regarded as more powerful than chemical decomposition. Rainfall, sometimes heavy, is almost limited to January and February. The rest of the year is dry and hot. Under the influence of powerful insolation, the rocks scale off in layers, often with an explosive report like a pistol shot, leaving a firm and smooth surface from which it is often difficult to hammer a hand specimen; further disintegration produces coarse sand in great quantity. The sand, sometimes cemented into a ferruginous rock, fills all the valleys; the intermittent rivers are choked by it. "The sand is, in short, leveling up the country again and obliterating the original corrugation of the land;" but this explanation is again very questionable in implying that the rock surface owes its form essentially to deformation. The same may be said of the statement, "The river valleys are wide and seem to suggest an immense drainage" at some former period: the important factor of time is not given sufficient consideration here, for with time small rivers may develop broad valleys. That deltas and mangrove swamps are encroaching on the shore may be well believed; but the large share attributed to faulting in shaping the coastal belt, which is said to have been unevenly uplifted to heights of 300 feet or more, needs confirmation: "it is humpy and broken and cut by innumerable faults, suggesting that it is being raised on the growing folds of the hard strata beneath." The best harbor, Pemba Bay, is described as enclosed by an upfaulted arm of land. The sea bottom is shelving, with numerous sand banks and coral islands. Terrific cyclones ravage the coast periodically—their season is not stated—and cause fearful destruction to life and property.

The region is evidently afflicted by its hot climate. It is a "place in the sun" with a vengeance. There are no natural resources from which an early return from invested capital can be expected. The half million natives are of a low order of intelligence and industry. Many of them have been converted to Mohammedanism by Arab and Indian settlers. The only thrifty element of the population seems to be the Indian traders, in whose hands lies the bulk of the traffic and who turn the alternation of seasons to their profit. They store the crops which they buy cheap from the natives at the end of the short wet season when food is plentiful, and then sell out at any price later on in the dry famine season. The improvident natives "die of starvation by thousands every year." Although Walls recommends irrigation, presumably by means of reservoirs, as a cure for the present discouraging conditions, it is to be questioned whether any such remedy will be introduced by the Portuguese, who seem unable to cope with the difficulties of the situation. They have not kept up various improvements introduced, apparently as military necessities, during the World War. Roads then made have been obliterated by the rapid growth of vegetation in the wet season; bridges have been washed away by rivers in flood; a steam sawmill has rusted into decay; a water-supply system for Port Amelia on Pemba Bay has been made useless by landslides in the soft muds of the coastal belt; at the end of 1920 a cyclone destroyed the pier, the hospital, and most of the houses of that attempted port; buoys which for a time marked the harbor shoals have disappeared. Verily, a territory without natural resources in a torrid climate would seem to be a possession hardly worth possessing.

W. M. Davis

ASIA

The Northern Sea Route to Siberia and the Norilsk Coal Region. The sea route to the mouths of the Ob and Yenisei Rivers is destined to become one of the main commercial links between Siberia and the outer world. The practicability of this route from the technical point of view and its value from the commercial have been demonstrated without peradventure during the last few years. Annual expeditions—British, Scandinavian, Russian—have shown that the difficulties of navigation through the ice-blocked Kara Sea and through the great estuaries can be surmounted. (*La Géographie* for March, 1922, pp. 285–287, gives an account of an expedition of five steamers to the Ob and Yenisei in 1921 under the command of Otto Sverdrup.) Radio stations have been built to keep vessels informed regarding the position of ice floes and other obstacles. There has been talk of increasing the number of these stations and of supplementing them with airplane scout services. Navigation is bound to become safer and speedier, freightage and insurance costs to become correspondingly lower. Siberia's foremost economic problem has always been her poor facilities for export and import. The Trans-Siberian railway, which did more than anything else to open up the country commercially, is already overworked and will soon become wholly inadequate to meet the ever-growing demands made upon it. Other railways now projected may be completed in the course of time but only at great cost. The plan of a system of canals linking together the upper reaches of the Siberian rivers and connecting them with the Volga and Europe on the one hand and with the Amur and Pacific on the other is still little more than an idle dream. The northern sea route, however, can be developed and improved at relatively slight cost. Even though navigation is open during a few short summer months only, freightage by this route will be far less expensive than by rail for unperishable commodities which can stand the delays occasioned by the long journey down or up stream and by the necessity of holding goods in storage throughout the winter at the rivers' mouths. Indeed, Danckwortt on page 57 of his "Siberien und seine wirtschaftliche Zukunft" (reviewed in this number of the *Geogr. Rev.*) maintains that freightage charges for shipping Siberian grain to London by the northern route may well amount to but half similar charges for shipments by rail to the Baltic ports or to Archangel and thence by sea to London.

The presence of coal deposits which form part of the immense Tungusk coal basin (see this number of the *Geogr. Rev.*, p. 289) near the lower course of the Yenisei will have an important bearing on the evolution of the northern sea route. The mining of coal in this remote district will make it possible for steamships engaging in trade by the northern route to fill their bunkers with Siberian coal for use on the return voyage instead of having to bring coal with them from Europe for this purpose. A saving of no less than 17 per cent tonnage can thus be effected.

Coal is found in the Norilsk region, about 50 miles to the east of the village of Dudinka on the lower Yenisei (see map in this number of the *Geogr. Rev.*, facing p. 292). The country between these deposits and the river and also extending some distance to the east was explored in 1919 and 1920 by an expedition sent out by the Siberian Geological Committee (which became in 1920 the Siberian Section of the Russian Geological Committee). The official report upon these explorations throws some new light upon the geography as well as the geology of this portion of northern Siberia (N. N. Urantsev: The Norilsk Coal-Bearing Basin, *Bull. Siberian Section of the Russian Geol. Committee* (*Izvestiya Sibirskago Otdeleniya Geologicheskago Komiteta*) Vol. 2, No. 1, Tomsk, 1921).

A map on a scale of 1: 210,000 accompanies the report. The map was based upon the astronomically determined geographical co-ordinates of four points (Potapovskoe village, latitude 68° 41′ N., longitude 86° 15.6′ W.; a point near the headwaters of the Dudinka River, latitude 68° 53.7′ N., longitude 87° 6.5′ W.; Norilsk coal fields, latitude 69° 19.6′ N., longitude 88° 8.′ W.; and Dudinka village, latitude 69° 24.9′ N., longitude 86° 9.2′ W.; magnetic declination at Potapovskoe: 21° 37.8′ E.) and upon reconnaissance surveys. It was also compiled in part from other maps, notably those contained in an atlas of the Yenisei made in 1919 from data obtained during an expedition under B. A. Vilkitsky.

The easternmost portion of the region explored forms a vast plateau of horizontal strata, the general level of the surface of which lies some 1700 to 2000 feet above sea level. The surface of this plateau is a peneplain now entering upon the initial stages of a new cycle of erosion. Farther west the borders of the plateau have been more maturely dissected by the streams flowing into the Yenisei, and consequently the relief is here fairly bold. The valleys have been cut to a depth of from 200 to 260 feet below the intervening hills and ridges. It is in this zone that the coal beds are found outcropping along the slopes. Still farther west a marshy plain, studded with low hillocks and diversified by numerous lakes, constitutes a belt some fifteen to twenty miles in width along the Yenisei.

The Yenisei itself is here a great, sluggish stream varying in width from three to seven miles. So slow is the current that the wind sometimes raises the level of the water ten feet and more. A recent gradual uplift of the continent or a relative lowering of the level of the Arctic Ocean has caused the Yenisei and its tributaries to excavate their channels to a depth of some 100 to 130 feet. During a brief period spring floods in the main river force the water in many of the tributaries to flow backward in an upstream direction.

The climate is typical of continental Arctic countries. The mean annual temperature at Dudinka, determined from observations made during eight years, is 13.1° F. The mean annual precipitation is 10.5 inches, with a maximum of 2.12 inches in September and a minimum in March. The ice in the Yenisei breaks up between May 25 and June 5, and the river freezes again between October 1 and 10.

The region for the most part is tundra. Scattered islands of larch (*Larix sibirica*) occur in the valleys, and the hilltops are crowned with dwarf birch and alder bushes (*Betula nana, Alnaster fruticosus*). Genuine forests of larch and to some extent of birch (*Betula tortuosa*) and spruce (*Picea obovata*) are found in the valley of the Norilsk River.

The natives are nomads who wander in summer toward the Arctic coasts and betake themselves in winter southwards into the forests. Further details about native life along the lower Yenisei will be found in an article by H. U. Hall in the *Geographical Review*, Vol. 5, 1918, pp. 1–21. Russian villages exist only along the main river at distances of twenty or more miles from one another and rarely contain more than three houses each. Even Dudinka, the "capital" of these extreme northern villages, has but twelve houses and only from sixty to eighty inhabitants.

History of the Post in China. The history of the post in China is an interesting comment on the country's civilization. China has the most ancient of postal services. The system of government posts, *I Chan*, is mentioned in the records of the Chou Dynasty the beginnings of which date back 3000 years. For long the *I Chan* remained the only organized postal service. The Chinese, however, as H. B. Morse says, are essentially "a literary and commercial people and in both capacities a letter-writing people." By the beginning of the fifteenth century a system of private posts was in operation. These early companies originated in the province of Chekiang and developed into the powerful letter *hongs* that have served the people long and well.

From the national viewpoint the chief defect of the letter *hongs* was that they naturally developed only the profitable routes. The first suggestion for a truly national postal service came from outside, from Sir Robert Hart, Inspector General of the Imperial Maritime Customs. An attempt had previously been made to meet the needs of the foreign communities. The first post office along western lines had been opened in Hongkong as a branch of the London Post Office, and subsequently branches were opened in other ports with mail steamer connections. It was not, however, until 1896 that a national service was established by Imperial decree. The Imperial Post was then organized on western lines under Sir Robert Hart. In 1911 it was separated from the Customs, and the following year the work of the *I Chan* was merged with it. In 1914 China formally entered the Postal Union, and the latest step in the history of the postal service is the withdrawal at the end of 1922 of all foreign posts according to the provision of the Washington Conference.

Details of the modern development of the Chinese Post Office are given in the last official report (Report on the Chinese Post Office for the Tenth Year of Chung-hua Min-kuo (1921), Directorate General of Posts, Ministry of Communications, Shanghai, 1922). In view of the competition encountered against the government and private services and the difficulties of communication great progress has been accomplished. The records for 1920 show that 400,000,000 pieces of mail matter were posted and parcels to the weight of over 20,000,000 kilograms; there were over 10,000 post offices and agencies and about 233,000 miles of mail lines, of which about 158,000 miles were major courier lines. China has the longest overland courier line in the world, the 4400 miles from Peking to Tihwa in Chinese Turkestan. The romantic side of the Chinese Post is well depicted in the illustrations accompanying the report and showing the varied means of mail transportation—by wheelbarrow, mule litter, bullock cart, buffalo-skin raft on the Yellow River, camel from Kalgan to Urga, post boat up the Yangtze rapids, sledge in Manchuria, and finally the arrival of the first mail-carrying airplane from Peking to Tsinan.

Chinese Geography of the West in Antiquity. The history of the eastward spread of Western geographic knowledge in Antiquity and the Middle Ages has been made familiar through Sir Henry Yule's "Cathay and the Way Thither" and through the investigations of Henri Cordier. Its converse, the history of the westward spread of Chinese geographic knowledge, is less thoroughly understood, though the pioneer studies of Friedrich Hirth (in his "China and the Roman Orient," 1885) throw much light on this obscure subject. Albert Herrmann, in a paper entitled "Die ältesten chinesischen Karten von Zentral- und Westasien" (*Ostasiatische Zeitschrift*, Vol. 8, 1919–20, pp. 185–198), aims to supplement the work of Hirth "particularly on its geographical side." Herrmann's purpose is twofold, to reconstruct from Chinese documents certain maps of Central and Western Asia that presumably were drawn between the second century B. C. and the seventh of our era, and to interpret the geography which these maps presumably set forth.

The reconstruction of lost maps, as is all too well known from the bitter controversies that have long raged over Ptolemy and over the origins of the medieval *mappaemundi* and portolan charts, is an extremely hazardous business, made doubly hazardous, when, as in the case of texts of the Han and Tsin Dynasties discussed by Herrmann, we have no definite assurance that the texts had any connection with maps whatsoever. The ground is perhaps a little surer when we turn to an early seventh-century treatise, where a map is distinctly mentioned. In any case judgment should be suspended in respect to the details of Herrmann's identification of place names until the matter has been more thoroughly threshed out by students of Chinese geography, philology, and history. However, it is probably safe enough to accept his outstanding conclusions.

The latter make it clear that the development of Chinese knowledge of the West bears some striking resemblances to the development of European knowledge of the Extreme Orient. Greek geographers of the Hellenistic period were often wont to assume that the eastern extremity of Asia and the ocean encircling the *οἰκουμένη* (or known world) lay not far beyond the confines of Iran and India. Similarly the Chinese of the early Han Dynasty (206 B. C.–220 A. D.), looking across Asia from the opposite point of view, conceived of their *οἰκουμένη* as a rectangle surrounded by oceans. They placed its western shores somewhere in Turkestan. Among the Greeks there were many who thought it possible to sail from the Caspian Sea directly around to India. Correspondingly, a Chinese conqueror in 138 B. C., who had heard rumors of the Aral Sea and Persian Gulf, appears to have believed that these were connected with each other and together constituted the waters of the Western Sea. At a somewhat later period, through the collection of merchants' itineraries, much geographical information about Inner Asia was spread eastward to China and westward to the Roman world. From these sources Chinese scholars were able not only to gather together enough details to give a fairly comprehensive idea of the main cities and lines of trade of Central and West Central Asia but also to extend their view as far as the Mediterranean. From similar sources it seems likely that the Romans of the early empire and Marinus of Tyre obtained that shadowy knowledge of overland routes towards China or the land of the "Seres," which make such interesting reading in the "Natural History" of Pliny and the "Geography" of Ptolemy. It had thus come about that after ages of parallel development each oblivious to the other's existence, the peoples of the Mediterranean basin and of the Yangtze and Hwang Ho valleys were brought, at approximately the same epoch, within the geographic horizon each of the other.

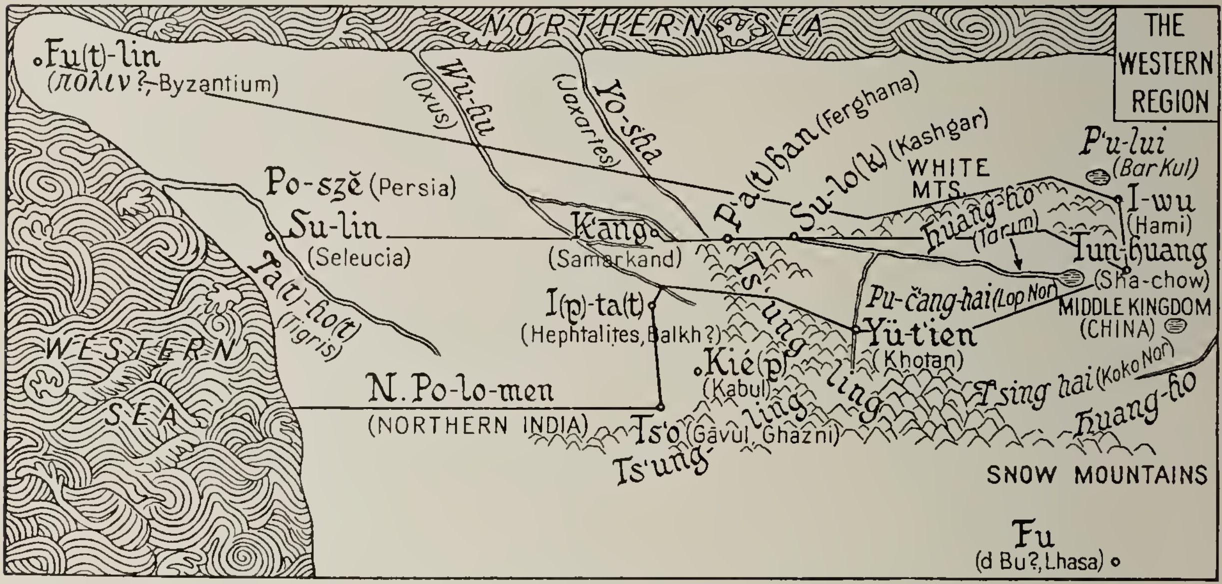

Fig. 1—Simplified outline of Albert Herrmann's reconstruction of a map which probably illustrated the "Memoir with Figures on the Western Region during the Sui Dynasty" written by P'ei Kü, 605–606 A.D. The straight lines on the map indicate three main highways from China to the Far West.

Ta Ts'in, or Syria, which became known in China toward the close of the Han Dynasty, is described in an historical text dating from 437 A. D. as a peninsula and is compared with Shantung. An Tu, its capital city, is to be identified with Antioch.

On the early seventh-century map reconstructed by Herrmann a city of Fu(t)lin appears in the northwesternmost corner of the known world. Hirth believed that this represented Bethlehem, but Herrmann argues in favor of Constantinople, Fu(t)lin being perhaps a

Chinese rendering of the Greek word πόλιν. It is well known that the Turkish name of Constantinople, Istambul, comes from the Greek εἰς τὴν πόλιν.

This map on which Fu(t)lin appears shows Asia bounded on the north and west by seas. Into the northern sea flows the Yo-sha (Jaxartes), and Wu-hu (Oxus); into the western, the Ta(t)ho (Tigris). Three roads diverge from Tung-hwang (Sha-chow in the Gobi desert, 350 miles east of Lop Nor) and make their way in a generally parallel course to the Western Sea. The northernmost of these runs first to Hami and thence, turning westward, goes almost direct to Fu(t)lin, crossing the Jaxartes and Oxus on its way. The middle road, after passing places which Herrmann identifies with Kashgar and Samarkand, reaches the Tigris at Seleucia. The southern road passes through Khotan, Balkh, and Ghazni, to Northern India, placed to the south of Persia on the Western Sea! A glance at the accompanying figure will show that this is crude geography indeed, but it is no cruder than corresponding ideas that prevailed in the West at the time in regard to the geography of the Far East.

GEOGRAPHICAL NEWS

Eighteenth Annual Meeting of the Association of American Geographers. The Association of American Geographers met at Ann Arbor, Michigan, December 27–29, 1922, for its eighteenth annual meeting. The sessions were held in the Natural Science Building by invitation of the Regents of the University of Michigan. The final program contained thirty titles, and all but four of the papers were duly read.

The full program together with abstracts of the papers will be published in the Annals of the Association of American Geographers, which is now issued in quarterly installments to members of the Association. All others will be furnished with gathered copies of the four numbers at the end of the year as heretofore.

Two papers in the final program were physiographic in character; three papers dealt with the subject of cartography; four had to do with climatology; and all the rest were in the field of human or regional geography. The Presidential Address of Professor Harlan H. Barrows dealt with "Geography as Human Ecology." Four papers in a group dealt with the Great Plains, their climate, vegetation, soils, and agriculture; and the group was introduced by a synoptical paper on land economics and followed by a round-table discussion of "Problems in Land Utilization." Through the courtesy of Mr. William S. Clements, one of the Regents of the University, the members of the Association and their guests had the opportunity of inspecting his notable collection of old maps and atlases.

The variety and character of the papers presented bore eloquent testimony to the vitality of the Association and its constant trend in the direction of human geography. From small beginnings nearly twenty years ago it has grown to be one of the substantial associations of scientific men in the United States.

GEOGRAPHICAL REVIEWS

The Economic Geography of Siberia

P. W. Danckwortt. **Sibirien und seine wirtschaftliche Zukunft: Ein Rückblick und Ausblick auf Handel und Industrie Sibiriens.** xii and 271 pp.; bibliogr. *Osteuropa-Institut in Breslau, Quellen und Studien, Section 7, No. 2.* B. G. Teubner, Leipzig and Berlin, 1921. 8½ x 6 inches.

Since the World War Germany has been looking eastward towards fields where she hopes ultimately to regain something of her lost commercial position and political prestige. If the doors leading to Africa and the Pacific are definitely locked against her ambitions, those of Russia, Siberia, and Central Asia may yet be opened, and she only waits to enter when the time is ripe. Meanwhile she purposes to survey the ground and to educate herself in everything that pertains to the lands beyond her eastern frontiers. One of the foremost agencies that she has created in order to carry out this program of self-education is the Osteuropa-Institut, founded in Breslau in 1918. The book before us is one of an elaborately conceived series of studies now being published by the Institut, a series which will deal with the geography, as well as the economic and intellectual life, of eastern Europe and the neighboring countries.

Danckwortt's volume is a veritable encyclopedic manual for the politician, trader, or investor, crammed full of detailed facts and statistical tables. Most of the latter date from before 1914, for the presumption is that any figures available from the period since the war are highly unreliable. The writer is severely sceptical of Russian estimates in regard to Siberian economic potentialities and claims that his conclusions are based either on personal observation or on the testimony of German prisoners; never on the verbal assertions of Russians.

After a preliminary regional sketch of Siberia as a whole and of Siberian internal and foreign commerce before 1914, Danckwortt writes in detail of climate, communications, agriculture, hunting, fisheries, mineral resources, and manufactures. He closes with some important observations on the history of Siberian industry since the revolution, its collapse at the fall of the Kolchak régime, and on German prospects in Asiatic Russia.

The book is more than a compilation of economic details. Danckwortt is embued with the spirit of the geographer as well as of the economist, and he envisages many of the economic problems of Siberia in terms of environment. The influence of environment is immediate, frequently all-powerful, in enormous and sparsely settled colonial tracts like Siberia. The extreme continental climate and the vastness of the area in proportion to the number of its inhabitants are the outstanding environmental elements in Siberian life. Danckwortt believes, however, that the climate is on the whole not quite as frightful as it has been pictured. We are prone to forget that Siberia covers over thirty degrees of latitude; that some parts of it are relatively mild; and, above all, that the warmth of the summers admits of agriculture at localities far to the north. Summer wheat may be grown at Yakutsk, no more than 400 miles from the cold pole of the world (Verkhoyansk, where the mean temperature in January is 58° F. below zero). Snowfall, nowhere very heavy in Siberia, is heaviest in the Altai Mountains and in the western *taiga* or forested zone. In the *taiga* the protection of the snow renders the cultivation of winter wheat more successful than on the open, windswept steppes farther south where the temperatures are higher. Much of Siberia is characterized by tracts underlain by "fossil ice," strata of earth that remain perpetually frozen below a thin covering of soil which thaws out in the summer. This "fossil ice" does not prevent the growth of trees or other forms of vegetable life. Indeed, through its retention of water, it may even be beneficial to plant life. The southern limit of the area of frozen earth is determined as much by the distribution of snowfall as by temperature. In the west, the border line is held far north by the snow that mantles the ground and retains warmth. Near Lake Baikal, however, the line swings southward to the Chinese frontier, leaving the whole of eastern Siberia, except the extreme southeast beyond Blagovyeshchensk, in the region of frozen earth.

The problem of communications over the immense expanses of plain and highland remote from the narrow thread of railway is intimately associated with climate. There are but few constructed roads in Siberia. Navigation on the rivers and with it the possibility of export by the northern sea route (see this number of the *Geogr. Rev.*, p. 309) is open for two months of the year only. On the other hand communication by land is facilitated by the freezing over of the lakes, streams, and swamps which in winter offer level and unobstructed highways.

Agricultural land, forests, and mineral deposits are Siberia's primary resources. Significant progress has already been made in agriculture, especially in the west. Before the war the export of butter from the plains east of the Ural had assumed no small proportions. Danckwortt prophesies that Siberia is destined to become a vast granary which will ultimately supply the outside world with breadstuffs. The forests are an immense and very slightly known resource. Stretching the whole length of the country from the Ural Mountains to the Pacific, they are broken here and there by swamps and meadows along the river valleys and by burnt-over tracts—for the forest fire is a curse in northern Asia as in Canada. The character of the forest varies widely with the region. In the Amur and Maritime Provinces heavier precipitation gives the woods a thickness of growth and luxuriance that is lacking farther to the west. The mineral deposits of Siberia are unquestionably very great; but they are not thoroughly explored, and we should be on our guard against exaggerated estimates of their extent or wealth.

Siberia's greatest needs are capital, labor, and improved routes of communication whereby her natural resources may be made available, and the manufactures fostered that are essential to the establishment of her present and future population on a sound basis. Only these will enable her to recover from the period of "industrial insanity" (as Danckwortt characterizes the Bolshevik régime) which she has gone through during the last few years.

Danckwortt believes that the Russians are incapable without aid from abroad of achieving economic prosperity in Siberia. He indulges in much comment that is possibly a little hypercritical on the visionary and impractical qualities of the Russian character. Nor does he ever fail, when he has the chance, to laud Germanic intelligence and enterprise, especially as shown by German and Austrian prisoners of war. It is not easy for us to accept at its full face value his vivid account of the stimulus which these prisoners gave to Siberian industry nor to believe that the economic breakdown and confusion that followed their repatriation was due altogether to their departure. Danckwortt sees Germany's opportunity in Russian incompetence.

But apart from its German bias, Danckwortt's book seems to be conservative and sound, an admirable introduction to the economic geography of a region about which reliable information is all too difficult to obtain.

Regional Geography of the Balkan Peninsula and the Greek Mediterranean

Giotto Dainelli. **La regione balcanica: Sguardo d'insieme al paese e alle genti.** iv and 124 pp.; maps. Soc. An. Editrice "La Voce," Florence, 1922. 7½ x 5½ inches.

Otto Maull. **Griechisches Mittelmeergebiet.** 132 pp.; maps, diagrs., ills., bibliogr., index. Jedermanns Bücherei. Ferdinand Hirt, Breslau, 1922. 7½ x 5 inches.

These little books are models of compact regional description written for the layman by the professional geographer. In each, after some preliminary general discussion of the respective regions, physiography, climate, vegetation, and human geography are taken up in logical order. There is constantly kept before the reader's mind the relation between environment and human life and between the whole and its component parts. Influences of environment are not exaggerated, and due weight is given to historical and ethnographic forces in determining present conditions of life. Dainelli covers the broader field and aims to set forth in bold outline a relatively few essential facts and ideas. Maull has produced a work of finer texture. The German love of minute analysis appears in numerous passages in small type and in a detailed description of local regions forming Part II of "Griechisches Mittelmeergebiet." Maull's material, however, is well arranged and well expressed, and there is little danger that the reader will lose sight of the unifying structure of the argument through the meshes of its elaboration.

Dainelli frankly and generously acknowledges an immense debt to Jovan Cvijić. Indeed there is not much in his book which is not developed far more fully in the Serbian professor's fundamental "La Péninsule Balkanique" (Paris, 1918; see *Geogr. Rev.*, Vol. 9, 1920, pp. 199–204). On the other hand, the work of the Italian is in no sense one of servile imitation or of plagiarism, and there are many subjects in regard to which its author disagrees with his Yugo-Slav colleague. For instance, though in general accepting Cvijić's natural regions, he modifies their borders. National feeling is perhaps joined to zeal for truth in his rejection of Cvijić's claim that the Balkan Peninsula extends as far as the Isonzo in a northwestward direction. Dainelli places its northwest limit just short of Fiume. There is also possibly a trace of national feeling in his qualified acceptance of Cvijić's assertion that the patriarchal régime of the Balkan region cannot be regarded as belonging to an inferior status of civilization. If not inferior in an absolute sense, Dainelli says, it is relatively inferior, and very much so, to the majority of the other civilizations which have had their origins in or have penetrated into the Balkans. However, it must not be assumed from this that "La Regione Balcanica" is of a propagandist or tendentious character. It is the work of a geographer, not of a political agent.

Writing for his non-technical countrymen, Dainelli's purpose is to give as succinct account as possible of a region in which proximity and political contacts have aroused a deep interest. His primary concern is accuracy and lucidity of thought and expression.

Dainelli contends that the region as a whole should not be called a peninsula, that it has none of the well-defined homogeneity of the Italian and Iberian peninsulas, and that only south of the latitude of Corfu or Saloniki is it truly peninsular. This is more than a mere verbal matter, for in the uncertainty of its actual, as distinguished from its artificial, limits towards north and east may be found a clue to much Balkan history and geography. Danube and Save are not more real barriers to climatic, ethnic, and cultural influences than the Straits or the island-dotted Aegean. From the west, however, except for the Dalmatian coast, the Balkan region is difficult of access, and even from north and east only its fringes are easily penetrated. The heart of the region, owing to the broken character of the relief, subdivided by mountains and plateaus into countless separate valleys and inclosed basins, is an area of geographic fragmentation in every sense. The peoples and civilizations that have succeeded in penetrating this core of the Balkan world from the periphery, or from beyond, have all been shattered, Dainelli asserts, with much reason, as a result in large measure of the influence of the geographic surroundings in which they have found themselves, and are now represented in a multitude of isolated and often mutually hostile communities and cultural islands.

Dainelli's thesis is the lack of geographic unity of the Balkan region; that of Maull the remarkable geographic unity of a region which is partly included in the Balkan area but lies partly beyond its limits. The two books thus supplement each other. Maull's Greek Mediterranean region comprises the Hellenic Peninsula, the Aegean Sea with its islands and northern borderlands, and the western fringe of Asia Minor. The historical unity of this region in ancient times has often been emphasized; Maull professes to be the first to treat it as a closed and compact geographic unit. Much of the value of the book lies in the originality of this conception and the skill with which it is worked out.

Dainelli does not provide the selected bibliography and collection of photographs which form such useful features of "Griechisches Mittelmeergebiet." On the other hand, Dainelli's maps will probably be of more service to the average reader because the principle has apparently been followed that all names mentioned in the text shall be shown on one or another of the maps. Maull's maps, however, display an immense amount of special information in a very small space and well repay careful examination.

Would there were more books in English of the character and qualities of these!

Among the Indians of Ecuador's Primeval Forests

Rafael Karsten. **Bland indianer i Ekvadors urskogar.** Vol. 1, 219 pp.; ills.; Vol. 2, pp. 221–406; map, ills. Söderström & Co., Helsingfors, 1921. 9½ x 6½ inches.

In these volumes Dr. Karsten, of the University of Helsingfors, gives a general account of his social and ethnographic studies during 1916 to 1919 in Ecuador, particularly in the Oriente. The travels were made on funds from Swedish and Finnish sources, and the greater part of his ethnographical collections have gone to the Museum of Gothenburg.

The Oriente has been little explored; few settlements are correctly placed on the map, and the courses of the rivers are free interpretations (compare the article "Explorations in Eastern Ecuador," pp. 190–209 of this number of the *Review*).

Eastern Ecuador is described as one of the most beautiful regions in the world. Descending eastward from the Cordillera one first traverses the grass-covered high plateau and at an elevation of about 1500 meters passes into the tropical belt whose vegetation becomes more and more luxuriant as one reaches lower levels. Conspicuous are different kinds of palms; but it is particularly the richness of the undervegetation that gives the forest its character. On the Andean slopes the animal life is strikingly poor; but down on the Amazonian lowlands there is a teeming and variegated life, particularly abundant and colorful in the birds.

Of Indians Karsten visited the Colorados, living not far from Quito, and the Cayapas in the province of Esmeraldas; but most of his time was devoted to the study of the tribes in the forests of Oriente, particularly those living on the Pastaza, Upano, and Morana Rivers—the Canelos and Jíbaros. The Napo River was also descended as far as the confluence of the Aguarico.

The moral standard among the Indians not influenced by the white man's culture is very high. Crimes like homicide and theft are unknown in many tribes. The highly developed feeling for the community also expresses itself in great generousness, particularly in time of need. The boys are brought up in a Spartan manner, and the mode of life of grown people is very strict and governed by customs. Although as a rule the Indian does not express his feelings, he is far from being so hard as is generally supposed. In social respects the Indian woman is the equal of the man. In some tribes the women even exercise a sort of supremacy. At bottom the Indians are peace-loving. Their wars, in most cases, aim at revenge; and as soon as this is taken they are satisfied. Their sense of justice demands one life for one taken.

The Indians know a great many effective plant drugs, but practically they are rather poor medicine men and are exceedingly superstitious. (See also the article by Dr. Karsten "The Religion of the Jibaro Indians" in the *Bol. Acad. Nacl. de Historia* (Quito), Vol. 3, 1921, pp. 124–145, and Vol. 4, 1922, pp. 309–330.)

The legal position of the Indians who have come under the influence of the whites is the worst imaginable, and as a consequence these half-civilized and civilized Indians are morally far inferior to their "wild" brothers.

Ernst Antevs

Snowfall Conditions East of the Baltic

J. Letzmann. **Die Hohe der Schneedecke im Ostbaltischen Gebiet.** 65 pp.; maps, diagrs. *Acta et Commentationes Univ. Dorpatensis A: Math., Phys., Med.*, Vol. 2, No. 3. Tartu (Dorpat), 1921.

The present monograph comes as a welcome addition to the climatological literature of Europe. One of the deficiencies in our knowledge of European climates has been the lack of adequate data regarding snowfall, a deficiency that was especially brought home to the reviewer during the war, in connection with his studies of the climates of Europe in relation to military operations.

The district under discussion extends from the Gulf of Finland to the River Niemen. Observations of snowfall were begun there during the winter of 1890–1891. The number of stations fluctuated from year to year, reaching a maximum of over 100. Of these, 60 cover a sufficiently long period to be available in this investigation, which includes the years 1891–1910. The observations were made according to the regulations adopted by the Petrograd Observatory and included depth, the amount of surface covered by snow, the nature and appearance of the snow, the occurrence of snow squalls, etc. The data were all subjected to critical analysis and carefully scrutinized. The result is a complete and accurate presentation, both cartographic and tabular, of the snowfall conditions of the area under consideration.

The portion of the monograph of the most general interest is that which concerns the geographical distribution of the snowfall. The first decade of November usually brings the first permanent snow cover, of an average depth of over 0.5 centimeters at some of the stations. Scattered places have an earlier snow cover which, in some years, comes in October. In the first decade of December there is snow all over the district, averaging from 1 centimeter to 10 or 11 centimeters. The coasts of the Gulf of Finland have the smallest amounts. By the middle of January depths of over 20 centimeters are found in a few places. The majority of stations have their maximum depths between mid-February and mid-March, there being a general increase in depth from the coasts inland. The greatest amounts are over 25 centimeters, mostly over the northern interior, back from the sea. By early May, in most years, there is no snow cover over 0.5 centimeters in average depth. Topographic controls are clearly indicated, especially in the south, the depth of snowfall increasing, as a rule, with increasing altitude up to 200–300 meters above sea level. There is also a close parallellism between the winter isotherms and the lines of equal depths of snow. Snow has fallen as early as September 21–22 (1866–1915). The 50-year records at the Dorpat Observatory show that July and August have been the only months without snowfall. The winter of 1899–1900 brought the greatest depths, averaging 24.5 centimeters. This amount seems insignificant when compared with the ordinary depths over much of the northern United States, but it must be remembered that the eastern Baltic region here under discussion has a modified continental climate owing to its position with reference to the adjacent water bodies.

It is a pity that the charts showing the mean depths of snowfall during the second decades of January, February, and March (the conditions between the 11th and the 20th being considered typical for the month) are not clearer and that the lines of equal depths of snowfall were not drawn on a base map showing the topography of the country.

R. DeC. Ward

The Explanatory Description of Land Forms

Alfred Hettner. **Die Oberflächenformen des Festlandes.** viii and 250 pp.; index. B. G. Teubner, Leipzig and Berlin, 1921. 8½ x 5½ inches.

Alfred Hettner, professor of geography at Heidelberg, has revised and extended in book form a number of articles which he had previously published in the *Geographische Zeitschrift*, of which he is editor. The book, addressed to advanced students and experts, purports to be a discussion of the fundamental principles involved in the genetic investigation and explanatory description of land forms. The contents show a wide acquaintance with the literature of the subject and afford a large amount of profitable reading, often provocative of helpful reflection, this being especially true of the pages in which the history of land-form theories is traced; but the book as a whole is not so much characterized by novel and constructive suggestions as by homilies, truisms, hesitations, obstructive misunderstandings, and disputatious objections. It is a conscientious but reactionary protest against what its author regards as the too hasty methods of certain other geographers.

The following examples of homilies may be instanced. If a supposition as to the origin of a land form springs into an observer's mind, he must test it before accepting it (p. 14). Scientific investigation must be first inductive and analytic; that is it must set out from observed facts and, beginning with the simplest, test all possibilities of explanation before it can go so far as to establish an explanatory principle (p. 47). Theoretical deductions must be tested inductively by comparing them with observed facts (p. 32); this homily is held to be so important that it is stated twice again on later pages (pp. 167 and 214). Ideal block diagrams are to be recommended only when the ideas that they represent are correctly deduced; if the deductions are wrong, the diagrams are dangerous because they are so vivid (p. 246). Hettner solves this difficulty by using no block diagrams at all!

Among truisms are such statements as these. The earth's surface has been greatly modified by the action of superficial forces (p. 31). The side slopes of a valley are not the work of its stream but of weathering and soil creep (p. 33). The profile of a river is not controlled by fixed points at its head and mouth; the head point is worn lower as the river profile is developed (p. 37); it should have been added that the mouth point may be shifted forward by delta growth or backward by wave cutting. A knowledge of underground structure is necessary in studying surface forms (p. 142). Ancient peneplains, long buried and afterward stripped, must not be confused with peneplains of later origin (p. 150). Among the factors which determine the form of coasts is their age, that is the time during which they have been exposed to marine processes (p. 187). Homilies and truisms of these kinds are well enough for beginners, but if they are needed by advanced students and experts one must wonder what sort of teaching such students and experts have previously suffered.

A number of well-established matters are inquired into in so deliberate a way as to suggest that the author has recently felt or still feels hesitation about their verity. The down-valley migration of river meanders is thought still to need further demonstration by observation, and a German writer is quoted as doubting its occurrence (p. 38); from this it would seem that pertinent facts, such as are presented on the two-date, large-scale maps of the Mississippi, and highly specialized forms such as are seen in the unsymmetrical spurs of incised meandering valleys like that of the lower Mosel were not known well enough to be appreciated at their proper value. Features as familiar as valley terraces are treated as if still needing explanation of their three origins; namely, the weathering of horizontal strata, the incision of a new valley in the rock floor of an older valley, and the accumulation and partial removal of valley-floor deposits (pp. 52–57); these pages would have been more helpful if, assuming a knowledge of the three classes of terraces, discrimination had then been made between terraces of weathering and of revived erosion in masses of horizontal structure, and if explanation had been given of the important part played by rock ledges in determining the cusps of alluvial terraces. The possible production of valleys by fractures instead of by erosion is still held to be worth combating (p. 27). Much is made of the long-established principle that the resistance of rocks to weathering is not to be determined merely by their physical strength, as under a hammer blow (p. 134); and here it is asserted that an observer follows circular reasoning who infers without further inquiry that the strata beneath a strike valley are physiographically weak. But, as a matter of fact, such an observer, if he is properly trained, is only making a pragmatically reasonable deduction from a well-grounded induction; for, after one has examined the strata beneath many strike valleys and found them to be well soil-covered, while the strata in the inclosing ridges exhibit firm outcrops along the ridge crests—scores and scores of such valleys and ridges occur in the Alleghanies between Catskill and Chattanooga—why should one any longer hesitate to use the resulting induction as a basis for future deductions regarding other strike valleys?

The explanation of certain mountainous highlands of geologically modern deformation as being now in a second cycle of erosion, introduced by broad uplift after advanced erosion in a previous cycle, is held to be only an untenable speculation (p. 110; also pp. 118 and 149). The well-authenticated facts that have compelled the two-cycle explanation are not examined. Instead of accepting this explanation as an important step of physiographic progress, Hettner approvingly quotes Supan as considering it a declaration of physiographic bankruptcy (p. 139).

Although the book is nominally devoted to the fundamental principles of land sculpture, it is in reality for the most part a diatribe against the scheme of the erosion cycle and against an American geographer who has for the past forty years interested himself in the development of that scheme. The name of this unfortunate individual is mentioned, usually with adverse comment, on the average rather oftener than on every other one of the 246 pages of the text; his method of thinking on physiographic problems is heartily condemned in nearly every respect. The condemnation is based partly on curiously insistent misunderstandings, some of which will be next instanced, partly on a disputatious preference for some other method than that of the erosion cycle for treating land forms, as will be shown in later paragraphs.

One of the most pervading misunderstandings results in the discussion of the "age" of land forms instead of their "stage" of development. "Davis' genetic terminology is based primarily on the age of land forms" (p. 233). "It sounds like a paradox, yet it is true, that the Davis school, in which age is the third term [in the description of land forms], makes no attempt whatever to determine the real age" (p. 141). As a matter of fact, not age but stage of development is the third term; and, although stage of development manifestly depends on the factor of time, it is practically determined not by measuring the geological periods during which a given feature has been undergoing erosion but simply by its visible form.

It is repeatedly insisted that the proper relation between induction and deduction, as expressed in the homilies above quoted, has not been observed in the exposition of the erosion cycle, which is said to be chiefly deductive (pp. 49 and 72); and this in spite of the abundant verifications by which nearly all the deductions of the cycle scheme have been inductively tested. For example, at the close of a chapter in my "Erklärende Beschreibung der Landformen" which sets forth a series of elementary deductions—really for the most part based on inductions and given, as Hettner recognizes (p. 207), a deductive form only as a device of presentation—the explicit statement is made: "Whether the deductions are correct cannot be known until they are confronted with facts." In the next chapter the necessary confrontation is made, with the result of showing that while the deductions are as a whole correct they need modifications and extensions; and these are then proposed in a third chapter. But Hettner overlooks these verifications. In only one chapter of my book—the chapter on the arid cycle—was deduction carried far beyond observation; the reason therefor was explicitly announced to be the lack of sufficient descriptions of desert topography with which the deductions could be checked. Hettner, who has not traveled in desert regions, characterizes that chapter as "schematic and without meaning" (p. 213). Erich Kaiser, professor of geology at Munich, who has made a close study of the coastal desert of southwest Africa, states: "It is a region of the kind which Davis has deduced from the factors of an arid climate."

Hettner asserts that, with Davis and his pupils, the theory of peneplanation rests on a "geometrical construction" and not on observation of actual processes (pp. 94 and 95). In my own experience the theory of peneplanation first took form during the summer of 1883 in eastern Montana, where the broadly rolling plains, which cut the nearly horizontal strata at a small angle, are here and there surmounted to a height of 500 or 1000 feet by dike walls and lava tables, and where the essential processes of erosion, still in operation, are manifestly the ordinary processes of weathering and washing. A later experience on the plains of Siberia in 1903 confirmed the earlier one. The theory thus inductively originated is certainly not weakened because it is supported by deduction of a kind that Hettner derogatively calls a "geometrical construction."

Numerous disputatious objections are made to the plan of treatment adopted in the exposition of the erosion-cycle scheme. Among them are the following. It is insisted that the exposition should be opened with the consideration of detailed forms. That would be well enough for a summer course of study inductively based on field observations in a district of abundant and varied rock outcrops; but in a winter course of lectures for beginners in physiography at the University of Berlin, where a drift cover obscures all rock outcrops for miles around, it seemed to me preferable to begin with general principles of wide application, and to introduce details later. There would be little individuality in science, if everyone followed the same method of presentation. Objection is made also to the simple characterization of rocks as strong and weak, without mention of their composition (p. 134); but that was sufficient for introductory chapters; and in later chapters brief mention was made of chalk, clays, sandstones, granite, gneiss, lavas, and limestone. Hettner repeatedly urges that structure is not sufficiently attended to; yet "structure" is given first rank among the three chief factors which the recommended method of explanatory description should include. It is denied that this "method of structure, process, and stage," as it is briefly called, is "method" at all; it is said to be a "theory" (p. 189). But as a matter of plain fact it *is* a method and a well-ordered method, by which the theory of the erosion cycle is given practical application. The erosion cycle is condemned because it is "schematic" (p. 72). Of course it is schematic, as any other plan must be under which the immensely complicated facts of nature are intelligibly summarized; but it is not rigidly schematic, as Hettner implies; it is elastic and adaptable, and it may be elaborated as far as one wishes.

Emphasis is placed on the lack of new principles in the erosion-cycle scheme; it contains little that is original (p. 148). There has never been any question but that such factors of the scheme as upheaval, deformation, weathering, erosion, abrasion, and so on have long been familiar; whatever novelty the scheme may contain lies not in these factors but in their organized combination; and how far that is novel may be perhaps best judged by comparing Penck's chapters on "Die Erdoberfläche" in Scobel's "Geographisches Handbuch" in the editions of 1895 and of 1908; one is without any indication of the cycle scheme; the other adopts it fully. Yet a still stronger indication of the novelty of the scheme is Hettner's inability to do it justice, in spite of the time he has given to its examination; and also his blindness to the evident fact that practically all the refinements, the omission of which from a first half-year course to beginners he regrets, constitute natural extensions and additions which might be appropriately introduced in a second and more advanced course. Hettner would seem to prefer an all-at-once plan of presentation, which should immediately set forth, along with fundamental principles, all sorts of complications in the way of varied rock composition, diversity of structure, irregular upheavals, alterations in the nature and rate of erosional processes with changes of climate, and so on. My preference is for a first entrance into the subject with simple examples and then a gradual advance to complex examples; on the firm foundation thus constructed one may later embroider as many elaborations as are desired. As a matter of practical experience, the general scheme of the erosion cycle presented in the introductory half-year course at Berlin gave its hearers more work than most of them accomplished; only a fraction of them found time to perform the practical exercises by which the lectures were helpfully supplemented.

W. M. Davis

New Zealand Land Forms

C. A. Cotton. **Geomorphology of New Zealand. Part I—Systematic: An Introduction to the Study of Land-forms.** x and 462 pp.; maps, ills., diagrs., bibliogr., index. *New Zealand Board of Science and Art Manual No. 3.* Dominion Museum, Wellington, N. Z., 1922. 22s. 6d. 8½ x 5½ inches.

It has been remarked that, in a distant colony far removed from its mother nation, the element of remoteness tends to diminish conservative and to favor progressive legislation; a result to which emigrational selection contributes powerfully by keeping at home those of satisfied ambitions and of weak initiative and by provoking the departure of those having unsatisfied desires and the energy to satisfy them. The book above named, taken in contrast with certain books of the same object published in Europe, suggests that a similar consequence of remoteness may be found in science. The presence of preconceptions, preferences, and prejudices in an old country, where educational standards have been long established, may operate to retard the adoption of novel ideas and methods. Those grounds of objection to change have less force in a young country, where conventions are yet to be formed and where new ways of doing old things therefore may be freely judged on their merits and adopted if desired without encountering the opposition that is commonly aroused by the need of changing settled habits of thought.

Cotton's book is the work of a young physiographic geologist who for the past fifteen years has had abundant observational experience in New Zealand, who has carried into his richly varied yet compact field a trained mind unusually competent in the rational study of land forms and a skilful hand exceptionally successful in reproducing landscapes in simple outlines, and who, when it comes to describing what he has seen, has decided unequivocally in favor of a modern, genetic, explanatory method as against an old-fashioned and empirical method. Not only so: this decision does not remain an unapplied abstraction; it is given systematic application of the most practical and thorough-going kind in the book before us, where, after two introductory chapters on the science of geomorphology and on the structure of the earth's crust and the nature of sculpturing processes, the normal cycle of erosion is broadly treated in eight chapters, even to the point of describing resequent drainage. Then follow as many more chapters on special topics, such as faults, block mountains of which the southern island of New Zealand offers admirable examples, land forms built of rock waste, and interruptions of the normal cycle by crustal movements. Next comes a chapter on wind action, this subject being briefly treated because New Zealand includes no desert areas, four chapters on glaciers and glaciation, two on volcanoes, and four on coasts. All the chapters are copiously illustrated with ideal diagrams, landscape sketches, and half-tone views of local scenery, making 442 figures in all. The success with which type forms are matched with actual forms testifies to the remarkable physiographic wealth of New Zealand. A list of 101 reading references, including 20 titles by the author, and a good index close the volume.

The discriminating quality of Cotton's treatment may be indicated by a few extracts from his pages. The introduction states that the description of land forms must be explanatory in giving some account of their geological origin and yet that it must also be geographical in that it shall not distract attention from present form to a consideration of past geological processes. Brevity is secured by the use of an explanatory nomenclature. Concerning the relation of uplift by which a cycle of erosion is initiated, to erosion by which it is carried on, it is remarked that "it simplifies the elementary study of land-forms to regard this uplift as rapid. It is not to be regarded as ever sudden, or catastrophic, but it may take place so rapidly that the amount of erosion that goes on during uplift is small as compared with that which follows completion of the uplift. All uplifts are not so rapid as this, but the results produced by erosion will ultimately be very much the same whether the uplift is slow or rapid." As a mark of the author's devotion to the truly geographical aspects of geomorphology it may be noted that, in strong contrast to the highly geological treatment of the subject by German geographers, Cotton excludes all geological time names, even in the case of fossil peneplains in certain block mountains. Readers who wish for geological information about New Zealand can find it in Park's or in Marshall's handbook.

When Cotton's next volume, on the regional morphology of New Zealand, now in preparation is issued, that compact country will be better equipped with physiographic texts than any other similar area in the world.

W. M. Davis

The Physiography of Europe in Diagramatic Form

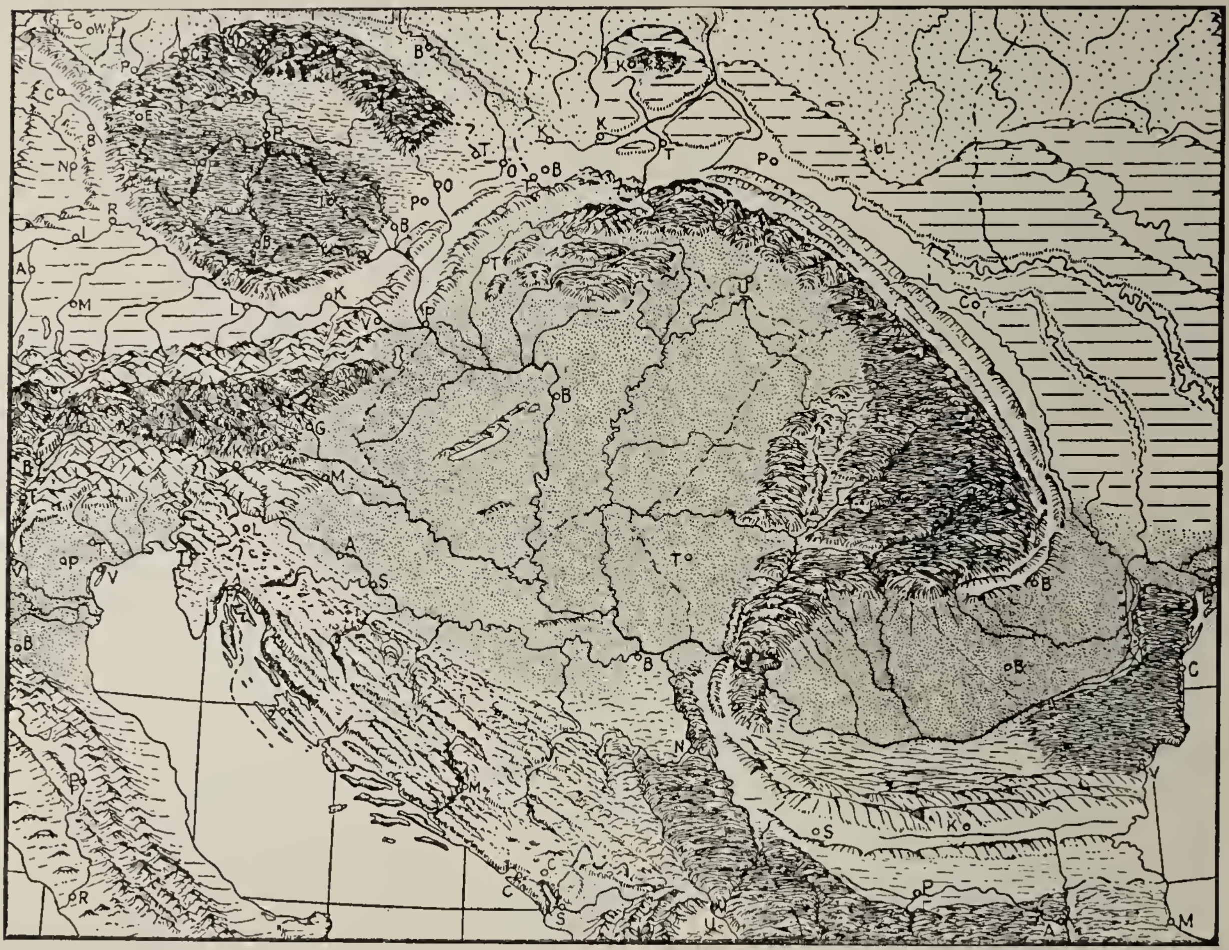

Fig. 1—Portion of the "Physiographic Diagram of Europe" reproduced on a slightly reduced scale—approximately 200 miles to the inch.

A. K. Lobeck. **Physiographic Diagram of Europe.** Small scale edit. Scale, approximately 1 : 9,000,000, or about 150 miles to one inch. 2 pp. of map and 6 of text. Wisconsin Geographical Press, Madison, Wis., 1923. 35 cents. 19 x 12 inches.

Professor Lobeck has furnished an admirable aid to the teaching of the physiography of Europe, following upon a similar device for the United States (1922). Omitting meridians and parallels from the land he has filled the space occupied by it with sketches and sketchy effects that represent the relief in more detailed expression than has yet been achieved upon our wall maps. Naturally the drainage is included; and upon the drainage lines, as well as in a few other localities, are placed the initial letters of towns so that the student may find his way about upon the political or commercial map in the event of comparisons with the physical map. To illustrate the character of the diagram a small portion of it is given above (Fig. 1) on a slightly reduced scale which approximates 200 miles to the inch. Near the center of the upper left-hand quadrant of Figure 1 is the letter "V" which stands for Vienna. Between it and the upper edge of the map is the basin of Bohemia.

The great central plain of Hungary is in the center of the map. The limestone ridges of the Karst country border the Adriatic, and its island-strewn coast suggests the manner in which the coast of Norway is treated. The scale is too small to permit a detailed representation of the relief of the Alps. One does not see the terminal moraines, and only for those who know where to look are the cirques expressed or suggested ever so faintly in the mountain forms of the Tyrol. West of the rim of the Bohemian basin are westward-facing escarpments which step down to the Rhine Graben outside the sketch on the west. The generally broken character of the Balkans is depicted on the southern edge of the diagram. A corner of the "Baltic plain" is represented by the stippled area under the upper frame of the map.

The map is accompanied by six pages of condensed text, consisting of thirty-seven numbered paragraphs, each one dealing with a principal physiographic province. A very great deal of useful information is compressed in these large pages, which measure nearly a foot in width and a foot and a half in height. Without seeking to diminish in any way the high value of the map and its accompanying text and exercises, a slight suggestion may be made with reference to the explanatory touches which are found in nearly every paragraph. These explanatory sentences ought to be thoroughly revised in the next edition. Without unduly emphasizing the defect which they represent, two of them may be given as samples, one in the field of physiography and the other in the field of human geography. "Its broken and discontinuous character is due to the numerous embayments of the sea. . . ." One rather supposes that this feature of "The Northwest Highlands with Associated Lowlands" has been gained as a result of depression of a well-dissected surface together with other agencies and that the broken character and the numerous embayments are alike consequences of the action of common agencies.

"Since this mountain district [the part of the Carpathian region that lies in eastern Czecho-Slovakia] has neither mineral wealth nor fertile soil, the Slovaks inhabiting it are a backward, depressed people with little aptitude for industrial life." The sentence might express a truth had the word "since" been omitted. As it stands it suggests the inquiry whether jollity and high spirits are necessary accompaniments of mineral wealth and fertile soil and depression the result of the absence of these two resources. Have the Slovaks really little aptitude for industrial life or rather little opportunity for exercising such aptitude as they may have?

A Study of Earthquake Frequencies

L. A. Cotton. **Earthquake Frequency, with Special Reference to Tidal Stresses in the Lithosphere.** Diagrs., bibliogr. *Bull. Seismol. Soc. of America*, Vol. 12, 1922, No. 2–3, pp. 49–198.

The greater part of Professor Cotton's interesting paper is a complete historical and critical résumé of the statistical work done in the attempt to correlate earthquake frequency with the seasons, the tides, the positions of the sun and moon, etc. The results of the immense amount of study along these lines have been disappointing. It is generally recognized that the principal cause of earthquakes resides in the earth itself, and that the influence of the seasons or of the heavenly bodies can only be of secondary importance, perhaps slightly advancing or delaying the actual time of occurrence of an earthquake. And so the investigators have discovered possible periodicities, with a greater frequency, by a small percentage, under some conditions than under others. But the results are by no means accordant, and the reviewer is inclined to believe with de Montessus de Ballore, that the periodicities obtained are accidental and do not reflect a real physical law. It must not be forgotten, however, that many competent students of the subject think otherwise.

The statistical method cannot explain earthquakes, it can only suggest an explanation; and so far it has not discovered anything of importance except the negative conclusion that no influence from outside the earth has any great effect on the frequency of earthquakes. In some cases it is difficult to imagine any possible cause for the period found. For instance, Omori found from three to six maxima within a 24-hour interval. What could cause such periodicities? The statistical method as applied to earthquake frequency is something like searching for objects in a dark room when you do not know in what part of the room to hunt and are not even sure the objects are there. To be sure, it is not always so bad as that; but undoubtedly earthquakes have sometimes been grouped by investigators in a way to hide a periodicity which, under a different grouping, might possibly have been found. The most promising procedure (which has been followed in some cases) is to determine the dynamic result of a given cause and then to see if the cause has been effective. Professor Cotton has followed this method in the latter part of his paper and has sought the position on the earth where the tidal forces due to the moon would have the greatest tendency to cause an earthquake. But, unfortunately, he has simplified the problem too much. G. H. Darwin, in his paper "On the Stresses caused in the Interior of the Earth by the Weight of Continents and Mountains (*Phil. Trans. Royal Soc. of London*, Vol. 173, 1882)," has solved the general problem, under some restrictions, of the equilibrium of a homogeneous, non-compressible, elastic earth under the influence of tidal forces. He finds that everywhere at the earth's surface the principal stresses would be perpendicular and parallel to the surface; therefore the greatest shearing stress would make an angle of 45° with the surface, and its greatest intensity is when the moon is in the horizon.

Professor Cotton's long historical résumé will be very useful to students of seismology; and he has made a good point in emphasizing the necessity of dynamical guidance for the successful statistical study of earthquake frequencies.

Harry Fielding Reid

Weather-Forecasting Reduced to a Science

L. F. Richardson. **Weather Prediction by Numerical Process.** xii and 236 pp.; maps, diagrs., indexes. University Press, Cambridge, 1922. 11½ x 9 inches.

This rather large volume by the former Superintendent of the Observatory at Eskdalemuir, Scotland, and at present Lecturer in Physics at Westminster Training College, is a remarkable book, perhaps the most remarkable of all meteorological treatises. It can have but a limited number of readers and will probably be quickly placed upon a library shelf and allowed to rest undisturbed by most of those who purchase a copy. It is a strikingly bold attempt to wake up weather forecasters; indeed, to make forecasting a science rather than an art.

The author alludes to Colonel Gold's "Index of Weather Maps" (*Meteorol. Office Geophysical Memoir No. 16*) in which the past history of a portion of the atmosphere over northwest Europe is used as a full-scale working model to indicate the current and consequent weather. But there is no valid reason for expecting to find in past weather maps facsimiles of current maps. Hence let us use processes resembling those by which the Nautical Almanac is produced, founded on differential equations and not upon "partial recurrence of phenomena in their ensemble."

The book had its origin in 1911 when the author became interested in the use of finite arithmetical differences in handling differential equations. The fundamental idea is that atmospheric pressures, velocities, etc., can be expressed as numbers and tabulated at certain latitudes, longitudes, and levels. Then, operating by an arithmetical method, new values for any given time interval can be obtained.

There is, however, a fatal weakness in the scheme in that local disturbances, or in the author's phrase "small-scale phenomena," must be smoothed out. But in our daily weather it is the small-scale phenomenon, or departure from the general flow, which works havoc with the forecasts.

Also in the integration of the fundamental equations, mean values are used. Now most observers know such values are not even the most frequent values.

The author excuses the failure of his method when applied in the one forecast made, by saying that it is "spoilt by errors in the initial data for winds." He believes that the pilot balloon stations were too irregularly distributed and too few. Such a confession, however, gives aid and comfort to the professional forecaster of today; and he will continue to rely upon surface conditions.

There are many unique signs and symbols and a much-needed page of guiding signs. Energy is expressed in ergs, not calories. The final chapter on "Units and Notation" will try the patience of most readers. A number of Coptic letters are introduced, lower case and upper case English and Greek alphabets plus all known mathematical signs not being sufficient to meet the author's need.

It took Professor Richardson six weeks to draw up certain computing forms, but he thinks an average computer would go ten times faster. To "race the weather," as he puts it, for the whole globe would require 64,000 computers. This leads him after much hard reasoning to play with a fantasy—a mental picture of the chief office of a World Forecasting Institution. But he does not lack a sense of humor, and in discussing possible analytical transformation of certain equations so as to shorten the process and incidentally give the public what it wants—namely, wind, rain, temperature, and radiation—he quotes the case of the philosopher who reduced all physics to a single equation. But it needed 12 large volumes to explain the symbols used in that equation.

Alexander McAdie

A Sixteenth-Century Belgian Geographer

Fernand Van Ortroy. **Bio-bibliographie de Gemma Frisius, fondateur de l'école belge de géographie, de son fils Corneille, et de ses neveux les Arsenius.** 418 pp.; ill. *Mémoires Acad. Royale de Belgique, Classe des Lettres et des Sci. Morales et Polit.*, Ser. 2, Vol. 11, Fasc. 2. Brussels, 1920. 10 x 6½ inches.

During the sixteenth and early seventeenth centuries the Netherlands led the world in scientific geography and in the art of cartography. Mercator and Ortelius, Hondius and the Bleaus are stars of the first magnitude in the history of these studies. Less well remembered, but none the less a leading figure, was Gemma Frisius (1508–1555), professor of medicine and mathematics at the University of Louvain, teacher of the famous Gerard Mercator. It would seem that nearly everything there is to be learned about the lives and bibliography of Gemma Frisius, his son, and his nephews has been gleaned by Van Ortroy and gathered together in this scholarly volume.

There is much meat here for the historian of geography who would dig it out. It means digging, however, for the salient facts are buried in a mass of less important details and bibliographical minutiae, and there is no index. Much is told of the work of Gemma Frisius, Cornelius Gemma, the Arsenius brothers, and their colleagues; but those who seek to learn where this work stands in relation to contemporary thought or to the history of science and of geography must supply their own background.

Though a student and professor of medicine—in the practice of which art as well he was by no means unsuccessful—Gemma Frisius by taste and talent was a cosmographer. Teaching, research, and publication in the field of cosmography, which includes much that is astronomy and mathematics as well as much that is geography, were for him more than avocations. They formed a second profession, as it were, in which he gained for himself a lasting reputation. His medical work is all but forgotten. The high quality of his cosmographic work was widely praised at the time and even won the recognition of the Emperor Charles V. Some of the compliments lavished upon him by contemporaries were possibly extravagant. Van Ortroy holds that in general he revealed less scientific originality of the highest order than of deep learning coupled with a sharply critical spirit. Gemma's thought was always more practical than theoretical, directed toward the devising of instruments and methods, the construction of globes, and the writing or editing of books to serve the practical needs of man.

From the geographical point of view, one of Gemma Frisius' most significant productions was a large map of the world, now lost, but whose character can be determined in a general way from extant descriptions. What is probably a small cordiform reproduction of this map has been preserved. The Belgian cosmographer also compiled and supervised the construction of terrestrial and celestial globes, one of the former having been engraved in part by Mercator. Gemma's version of the famous "Cosmographia" of Peter Apian went through many editions. Besides this, he composed a cosmography of his own, entitled "De principiis astronomiae et cosmographiae," in which a discussion of the principles of astronomical geography is followed by a geographical description of the regions of the world including the "islands recently discovered." Extensive extracts from the "De principiis" were inserted in some of the later editions of Apian's "Cosmographia."

Two passages in the writings of Gemma Frisius, which foreshadowed developments of fundamental importance in the arts of surveying and of navigation, reveal to us his practical and inventive cast of mind. The first is in a short treatise called "Libellus de describendorum locorum ratione," which was inserted in Gemma's editions of the "Cosmographia" of Apian after that of 1529. Here the use of triangulation as a basis for the construction of maps was first suggested. The writer proposes that an observer on the cathedral of Antwerp measure the angles formed between the meridian and the directions of other cities in sight, Brussels, Malines, Louvain, Ghent, etc., and plot these on a piece of paper. By repeating this process at a vantage point in one of the other cities he shows how it is possible to determine the relative positions of the cities by intersection. The other passage is in the ninth chapter of the "De principiis astronomiae et cosmographiae." Here it is shown that longitude might be determined by the use of small clocks. This method, upon which modern navigation in large part is based, did not become practicable until the eighteenth century, owing to mechanical imperfections in the construction of chronometers.

America and Mongrelism

C. W. Gould. **America, a Family Matter.** 196 pp.; map, diagr., ills., index. Charles Scribner's Sons, New York, 1922. $3.00. 9 x 6 inches.

"Human intelligence has waxed and waned. Many factors caused its decline from the great age of Pericles to the darkness of the eighth century. The endeavor of this essay is to search out the principal or fundamental cause of that mental degradation. The result is taken and applied to conditions now existing in our own country—America."

Such is the argument which prefaces the text of this volume. Why has not human progress been uninterrupted and of some definite and specific trend? The question has frequently agitated the minds of scientists as well as of historians; and conclusions which differ *toto caelo* one from the other have been arrived at. In the view of some the extraordinary deviations and fluctuations of humanity are due to an altogether natural process of growth and decay, attended by the springing up of new life. Others have suggested meteorological considerations; still others have argued the claims of economic pressure; geographic, hygienic, and ethnological theories have likewise been disseminated. But the matter is still a great deal of a puzzle.

Mr. Gould, who is not, apparently, a specialist in any particular field of learning, attacks the problem, if not from a new quarter, certainly with a fresh and interesting point of view and with a unique treatment. His imagination, it would appear, has been vastly stirred by observing the "mongrel" type among animals and biological causations through which the type is produced. He has, on the other hand, been much impressed by the virtues and merits of the "thoroughbred." So Mr. Gould adopts the simple stratagem of examining the pages of history with an eye to the effects produced upon the human race by the occurrence from time to time of mongrelism, which seems to alternate with pure-bloodedness. Somewhat artificially it would seem, he has divided the course of history into ten semi-millennial periods, commencing with the dawn of Egyptian history about B.C. 3500 and concluding at the year A.D. 1500; though it is not easy to see why the modern period should be thus slighted. Indeed, the entire Christian era is treated in some ten pages of the book, while upwards of eighty-five pages are devoted to a study of the Seventh Period of human activity—from B.C. 500 till the time of Christ. A top-heavy system of this sort surely loses much of its effectiveness.

An examination of those ancient peoples, the Egyptians, the Persians, the Greeks, and the Romans—their art, literature, ethics, course of progress, and political regimens—has led Mr. Gould to adopt the conclusion that each race and nation was at its best and greatest when its blood was purest and freest from foreign admixture. But as surely as the state becomes strong and prosperous, the alien is attracted into it. Fusion of blood results, at first gradual, finally on a grand scale; thence, mongrelism and degeneracy, resulting ultimately in total *Niedergang*. The nation that would keep its feet in the struggle for existence must needs keep not only its civic life pure but also its stock free from external contamination. It therefore behooves America to gird up the loins of her mind and exclude, at all hazards, the pernicious foreign element.

Mr. Gould may very possibly be correct in the main; he has, at least, on his side many eminent and sagacious authorities, including the veteran scholar of Columbia University, Professor H. F. Osborn, who maintains that the "melting-pot" theory is all wrong. But, however this may be, "America, a Family Matter" can hardly be termed a convincing or even a well-written book. The author has not taken time to clear the ground as he advances to the attack and so frequently falls into the barbed entanglements of erroneous statement. In spite of the occasional attempts at fine writing, his style contains something more than a suggestion of immaturity and even puerility. There is also a sad lack of proportion about the whole scheme of the book, and it is very manifest that the writer has failed to steep himself in historical lore. At least a score of lapses and blunders catch the eye, even on a rather hasty perusal.

Notwithstanding all this, one would be glad to see the theme developed and the theses of the book subjected to careful examination. Mr. Gould has given us a note of warning on a theme that deserves attention.

Alexander David Fraser

A Textbook in Economic Geography

Ellsworth Huntington and F. E. Williams. **Business Geography.** x and 482 pp.; maps, diagrs., ills., index. John Wiley & Sons, Inc., New York, Chapman & Hall, Ltd., London, 1922. $2.75. 8½ x 5½ inches.

This is a textbook for senior high school, business college, or for the first-year course in schools of commerce. It is not a compendium of useful knowledge for the business man or the embryo business man; but it is a textbook dealing with principles that govern the environmental influences affecting the production, exchange, and consumption of commercial products. It is wholly unlike economic or commercial geographies now in use in that its organization is along entirely new lines and also in its prominence of principles rather than facts. Indeed, the authors state in their preface that a course in economic and commercial geography is presupposed.

The subject matter is arranged in four parts, with a fifth part consisting of statistical tables. Part I (133 pages), entitled "The Geographic Principles of Business," discusses the great factors affecting business—climate, relief, soil, rain, transportation, etc. Part II deals with the business relations of typical communities—pastoral, dairying, temperate zone farming, tropical plantations, lumbering, mining, manufacturing, etc. Parts III and IV discuss the business of the continent and of the United States and Canada particularly. In these sections the authors approach the regional treatment yet describe only the main factors affecting production, consumption, and trade in these large regions. A very useful feature of the book is Part V which consists of 49 tables of data on area, population, occupation, land values, farm tenure, agriculture, mining, quarrying, lumbering, manufacturing, transportation, commerce, consumption, finance, education, and health. These tables, however, are something more than an appendix in that exercises and problems at the close of each main division of the text call for their use.

The work is original in its organization, scholarly in its treatment of principles, illustrations for which are drawn from the whole world, and will prove a valuable text. It will also prove interesting as a supplementary reader in the courses other than those for which it is intended as a text.

A. E. Parkins

The Exploitation of the Arctic

Vilhjalmur Stefansson. **The Northward Course of Empire.** With an Introduction by E. W. Nelson. xi and 274 pp.; map, diagr., ills., bibliogr. Harcourt, Brace & Co., 1922. 7½ x 5 inches.

This book is one that all economic geographers should read. It opens with a chapter which will delight geographers with its rich collection of facts proving the geographic ignorance of statesmen and our steadily increasing appreciation of northern lands. Here is one of these gems. "In 1763, at the end of seven years of war England and France made a treaty. The British, feeling that they were in a position to do so, asked among other things that the French turn over to them the island of Guadeloupe. To this the French replied in substance that they disliked extremely to give up Guadeloupe, as it was an island containing sugar plantations of great value to the citizens of France, and suggested they would much prefer to surrender Canada. To this the British replied that while Canada was larger than Guadeloupe, it was not good for much. There were, of course, some furs, and there were codfish on the Newfoundland Banks; but on the whole it was not a very valuable piece of property, and they much preferred Guadeloupe. After a prolonged deadlock Benjamin Franklin suggested through a pamphlet that, while Guadeloupe was more valuable than Canada, it was a distant island, while Canada was contiguous territory, and if we allowed the power of France to develop at our very door there would be continual friction. Eventually the British accepted Canada, apparently for political rather than economic reasons. And now not half of the readers of this book can find Guadeloupe without looking it up in the index of an encyclopedia."

One of the most important sections of the book gives a convincing statement of the now fairly well known fact that the Arctic tundra is in the process of becoming a great range or ranch for the reindeer farmer. Mr. Stefansson also advances convincing arguments to the effect that there is also great wealth to be added to the world's store by the domestication of the musk ox, Mr. Stefansson's "ovibos," an animal of surprising abilities at living in the open Arctic lands, picking his living, producing meat, wool, and possibly even milk. He also rather shames us by pointing out that we have not domesticated any animal of importance for the last 2000 years.

Plainly, the tundra is good for reindeer; and doubtless peoples native and accustomed to this zone can easily populate it. It is hard to understand how it could have any *home lure* for persons who know any other land. It is true that Mr. Stefansson loves it, but it is hard to understand how he can, after saying, as he does,

"Admittedly there will be some suffering during the period when the temperature ranges between 85 and 100 degrees in the shade, for prevailingly the North is humid and the heat will therefore have its fullest disagreeableness." . . .

"No matter how hot you are, you will have to wear thick enough clothing so they [mosquitoes] cannot sting through, with unpierceable gloves on your hands and a veil over your face." . . .

"Some say the sand flies are worse than the mosquitoes because they will get inside of your clothes and crawl all over you. This can be dealt with by wearing knitted cotton or woolen underwear that grips the body so tightly that flies cannot crawl under. That is a simple enough way theoretically but finds its objection in the fact that one does not like to be clothed that way when the temperature is around 90°."

Chapters on the advantages of the Arctic for aerial navigation bring out many interesting things, among them the shortness of the polar route between such places as London and Tokio and the superiority of the Arctic sea over any other sea for air travel because of the ease of sailing down to make repairs upon ice cakes rather than upon the bounding billows of the open seas.

J. Russell Smith

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THE GEOGRAPHICAL REVIEW

VOL. XIII JULY, 1923 NO. 3

THE HOUSES OF RURAL BRAZIL

By ROY NASH

"However rudimentary," says Brunhes, "the sleep shelter is still a definite point at which man installs himself for some hours and to which he is naturally inclined to return. Such is the origin of that very important fact of human geography, the habitation."

We shall use the term "house" as he does, to include all human structures; but, inasmuch as it is especially the rural house and the isolated dwelling that necessarily is built of local materials and most clearly exhibits dependence upon the geographical environment, we shall here shun the cities of Brazil. Every one who travels in South America knows Rio de Janeiro and Bahia, Santos and São Paulo; far fewer know well the interior.

PALM-LEAF HUTS

For the first type of Brazilian house let us observe this palm-leaf hut on the Banks of Breves, at the mouth of the Amazon (Fig. 1). Just some piles to raise the floor above the mud, three walls of woven matting, and some thatch; but a sleep shelter, a protection against the storm, and a place where the owner may accumulate nets and spears and all his beloved possessions. Such is the type that has risen in the plains of the Lower Amazon subject to annual floods—mere frameworks raised high on wooden piles and thatched with the leaves of the ubussú palm or the assai. The outer part of the stem of the latter species is hard and tough as horn. Split into narrow planks, it is used along the Tocantins for a large portion of the walls and flooring.

Up toward the headwaters of the Amazon the forest Indians build communal dwellings large enough to house the whole village.[1] The walls as well as the roof are covered with thatch of palm leaves. On festive occasions a *maloca* may shelter as many as two hundred naked dancers, and we know not how many chiefs sitting with their knees doubled in the burial urns beneath the trampled earth on which their descendants are dancing. With

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[1] Pictures and plans of *maloca* of the upper Amazon are given, for instance, in Thomas Whiffen's "The North-west Amazons."

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only two apertures in the whole great edifice to admit light and air and permit the smoke from the many fires to escape, it is fortunate indeed that palm thatch is porous! These communal dwellings were originally found from Colombia to Paraguay and eastward to Rio de Janeiro.

The *malocas* of the Upper Amazon are the limit of the palm-leaf house in the direction of magnitude. At the other end of the scale are such temporary shelters as the one shown from Matto Grosso (Fig. 2). Wherever men camp in the jungle for a brief sojourn, as do the *seringueiros* who gather rubber during part of each year, similar frail structures, which can be thrown together in an hour's time, are made to suffice for several months.

The palm-leaf hut in its various forms was one of the houses which existed in Brazil before the invasion of the Portuguese.

The Mud House

The vast majority of houses of rural Brazil are of mud. The *gaucho* who herds cattle on the pampas of Rio Grande do Sul, the *matuto* who plants his crops throughout the forest regions of the central plateau and along the littoral, the *sertanejo* who wrests a precarious livelihood from that dry region which extends from northern Minas to the coast of Maranhão and Ceará, and even those who live in the villages along the navigable rivers of the Amazon Basin, all build the same type of house. "Huts of refuge of the same dreary material as the hills" are as typical of Brazil as of Lower Egypt.

Possibly the mud house in some form or other was in use among the aborigines before the arrival of the Portuguese. It was known in parts of South America; wattle and daub, for instance, were characteristic of the Chibcha culture area. However this may be, the present prevalence of the mud house type appears to be a result of Portuguese culture. The mud house has always been common on the Iberian Peninsula and about the Mediterranean.

It may seem strange that a thing as ephemeral as the mud house should persist and keep the same general characteristics through the centuries in a country which has more standing timber than any other like area of the earth's surface. The fellah in the delta of the Nile lacks everything that is necessary to construct a solid dwelling, but the Brazilian has stone and wood and lime and fuel to burn bricks in abundance. What is the reason for this, beyond the tremendous force of tradition?

One reason is clear. There are, even today, only two establishments in all Brazil which would be classed by North American lumbermen as thoroughly modern sawmills. The boards used by the hinterland for the most part are whipsawed by hand, as for centuries past. While Brazilian forests are rich in an enormous variety of timbers, many are very hard and saw with difficulty. Whipsawed lumber is vastly expensive in labor.

On the contrary, nothing could be easier to build than the mud house of Brazil. Four corner posts and two to support the ridgepole are set into the

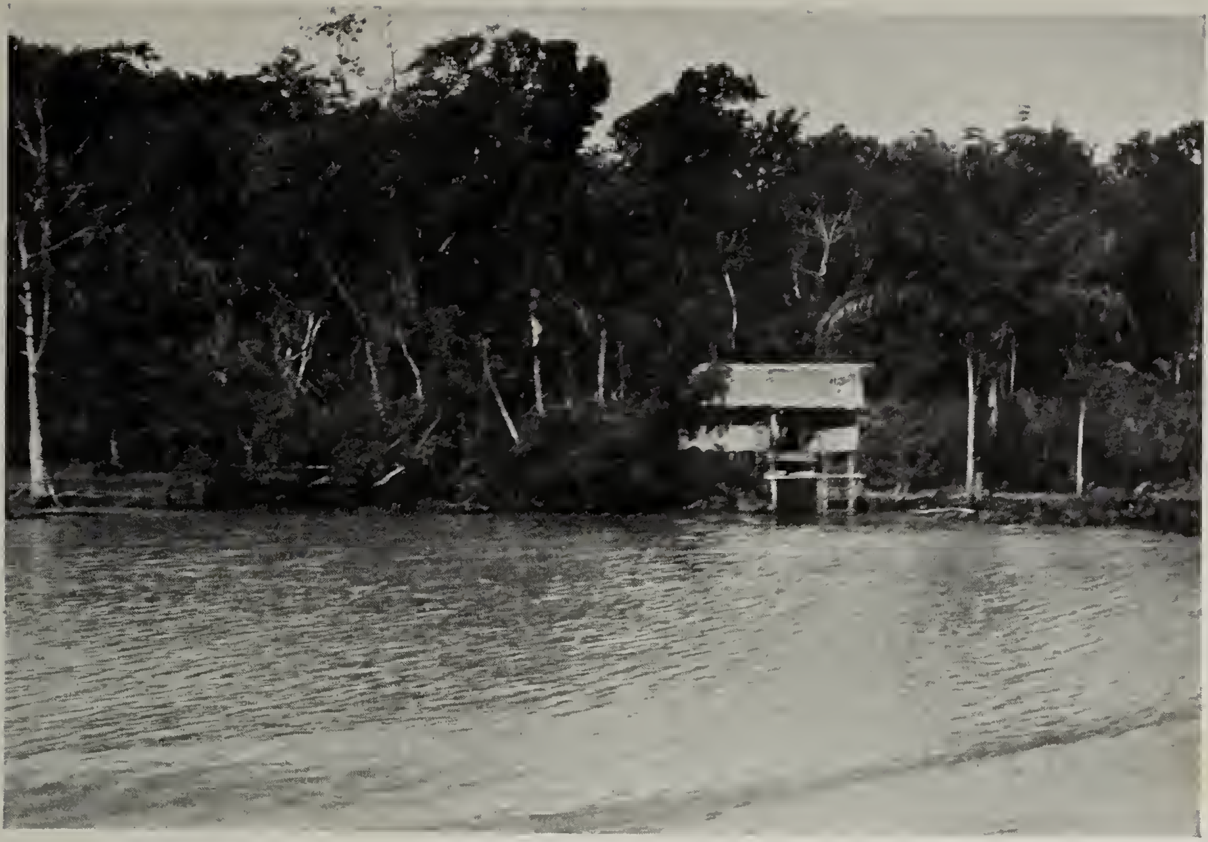

FIG. 1

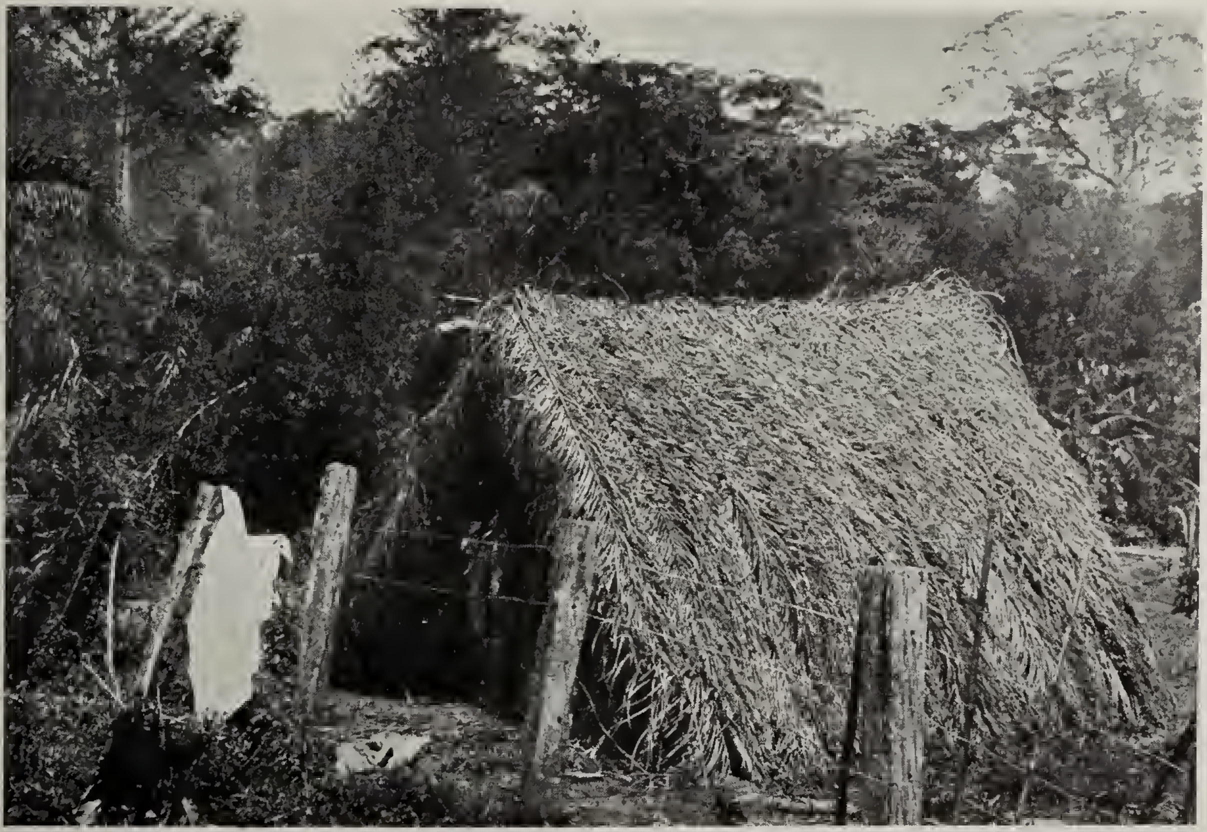

FIG. 2

FIG. 1—The palm-leaf hut of the flood plain of the Lower Amazon. It is raised on piles just high enough to keep the floor above high-water level. In the Breves channel, west of the Island of Marajó.

FIG. 2—The simplest form of palm-leaf hut. A temporary shelter in Matto Grosso.

ground, and rafters are fastened to their tops. If nails are expensive, the forest is full of flexible bark and *sipós* which make strong ties. The forest furnishes the builder with the saplings which are fixed vertically between the ground and the rafters a palm's width apart, and with the withes which are woven in horizontally until the walls are outlined as a wattlework of five or six-inch squares. Plaster into this wattle any good heavy clay, and you have a wall which will soon dry to considerable hardness.

The covering of the house is a more delicate and difficult problem. The fellah of Luxor may get along without any roof to his dwelling, but the *sertanejo* of Ceará, living in a land scourged by terrible droughts, must provide against occasional torrential rains. The thatch of palm leaves or grass, which we saw in Amazonas, is encountered on the very rudest type of mud huts in the outskirts of almost any village and on isolated dwellings in the forest everywhere; but the average Brazilian agricultural worker does better than that. He takes suitable clay from another pit, shapes it on a hollowed slab of wood, burns it in a simple kiln, and roofs his house with half-round tiles. These, like the mud of the walls, are supported on a wicker-work of saplings or on shakes split from a palm stem. The roofs of rural Brazil are usually two-sided and but slightly pitched, although four-sided roofs are not uncommon.

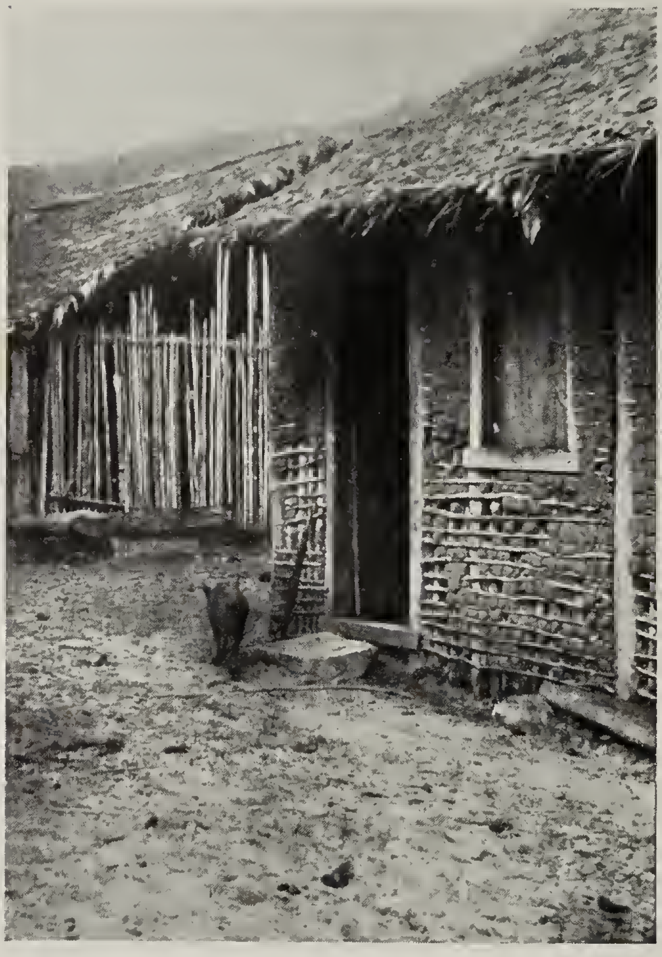

FIG. 3—The mud house with thatch of palm leaves. In the chinks of such unsurfaced walls and in the thatch live the *barbeiros*. Southern Bahia.

Trample down the earth over which this structure stands and you have an edifice which would delight a turtle: packed mud beneath, plastered mud around, burnt mud above. And no tool was necessary for its construction other than a jungle knife, the *facão* which every man owns.

Occasionally one sees whole villages where the dwellings are as miserable as that and are left in exactly that rough and unfinished condition.

In its simplest form, this rough house of mud will have but one room and a single door and window. Usually, however, there are partitions dividing it into at least three rooms; and, in all but the pitiful hovels of the most wretched, the walls are smoothed while wet. That is a simple thing—a smooth, hard surface in place of a rough wall full of chinks and cracks. Yet the difference between the one and the other may be the difference between life and death, as we shall see directly.

As the wealth of the occupant increases, there come certain regular steps in attempted embellishment. The first is the application of a wash of color to the smoothed walls—frequently blue, or pink, or green, more commonly whitewash. A veranda, however narrow and however high the eaves, is always a real addition of comfort and somewhat breaks the harsh lines of the packing-box proportions; and when the owner simultaneously acquires the capital and the energy to install a floor of wood, he has almost attained the ultimate goal.

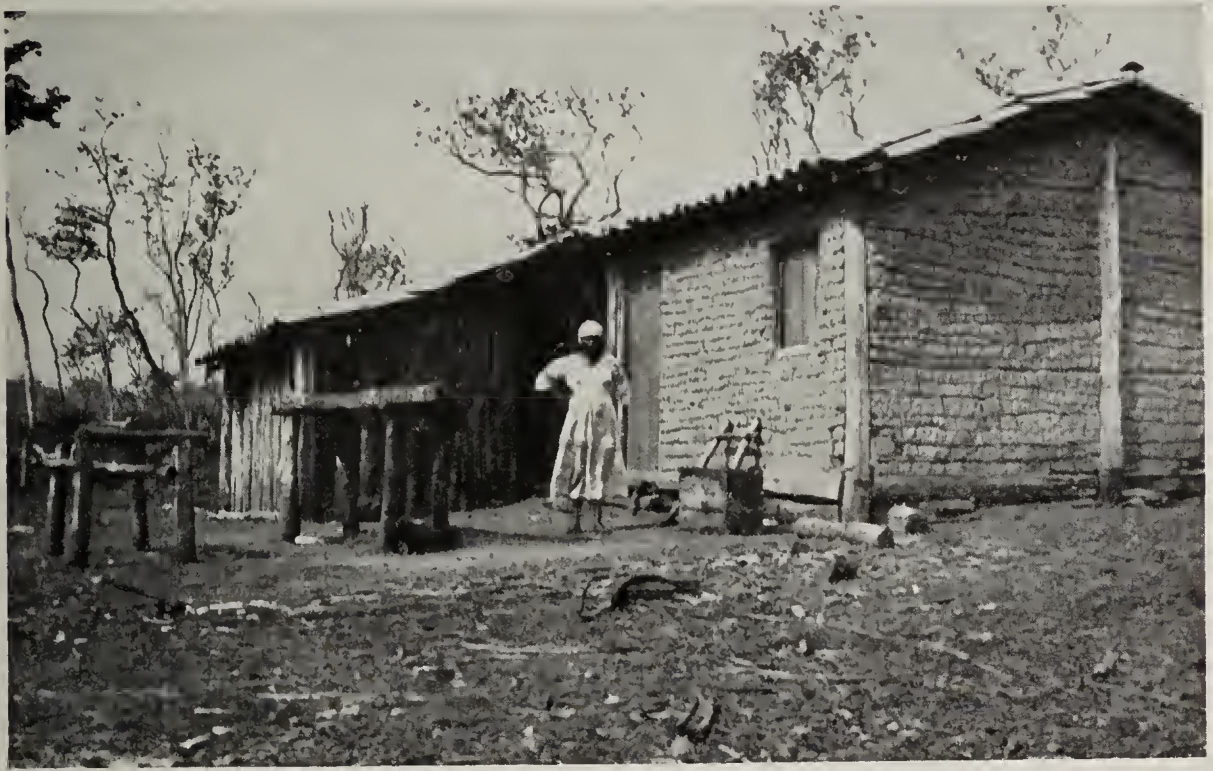

FIG. 4—Shows clearly the method of framing the mud house. Four uprights at the corners and two to support the ridgepole are the heaviest items in the construction. Aracanguá, in western São Paulo.

That, from the threefold standpoint of beauty, hygiene, and utility, is attained in the use of tiles as a wall surface. Just why the use of tiles should be so much more common from Maceió north to São Luiz, the region once held by the Dutch, than in other parts of Brazil is not apparent. It is distinctly a legacy of the Moors in the Iberian Peninsula. Tiles as a wall covering and decoration have been especially used in the lands of Arab civilization, arid lands where dried mud forms an important constructional material. "Indeed it may be said that tilework is the most characteristic feature of Portuguese buildings." "Towards the end of the eighteenth century blue seems to have usurped the place of all other colors, and from that time, especially in or near Oporto, tiles were used to mask all the exterior rubble walls of houses and churches, even spires or bulbous domes being sometimes so covered."[2] These blue tiles of Oporto are the prevailing fashion in house walls along the whole northeast coast of Brazil.

The addition of gilt pineapples, colored glass balls, fantastic waterspouts, pig-tailed corners, or birds of tile and mortar to the corners or ridgepole of a mud house piles horror upon horror. The ephemeral character of such habitations is their chief virtue, and one cannot be sorry that such unlovely excrescences do not endure as long, for instance, as the stone houses of the Breton peasant. In the mud villages of Brazil I suppose a house a quarter of a century old is a rarity.

But there is a kind of earth house which used to be much more common a hundred years ago than it is now, and some examples of this type have endured for upwards of two centuries. It is built on quite different principles and is altogether a more substantial structure. A form of planks, such as we use today in concrete work, is filled with earth, moistened and well tamped and gradually built up until massive structures two and three stories high have been reared. When the walls have thoroughly hardened they are pared smooth and tinted like the walls of the mud house. There are churches and monasteries in Brazil today which were constructed in this manner as long ago as the latter part of the seventeenth century.

Varying, then, between a one-room hovel with rough walls and a monastery with massive walls built up like the earthwork of a dam, enduring from two or three years to as many centuries but always reproducing itself, always remaining true to type, shaped both by tradition and by the natural environment, the mud house remains the sleep shelter of at least twenty millions of the humbler citizenship of Brazil. It is found from Amazonas to Rio Grande do Sul and from Pernambuco to the Bolivian border.

Unhygienic Nature of the Unsurfaced Mud Hut

If the rougher forms of the mud house have been characterized in some what uncomplimentary terms, it is through no lack of respect for the occupants, whose simple and generous hospitality the writer has so often enjoyed. At the same time there is good reason for condemning this hut which the illiterate millions of rural Brazil call home.

For it is the home, too, of the *barbeiro*, a house-inhabiting insect living only in the little chinks of the mud walls and within the thatch of *burity*—the bearer of the scourge called "Chagas' disease," *molestia de Chagas*. In speaking of the three great endemic diseases of Brazil Dr. Belisario Penna, the present chief of rural sanitation in the Brazilian Public Health Service, says:

> The most grave of all, because it is incurable, contracted in infancy, producing a high mortality, and generally disabling its victims, is Chagas' disease, the *doença do barbeiro*, which curses the population of more than seventy counties in Minas Geraes. I calculate

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[2] W. C. Watson: Portuguese Architecture, London, 1908, pp. 28 and 22.

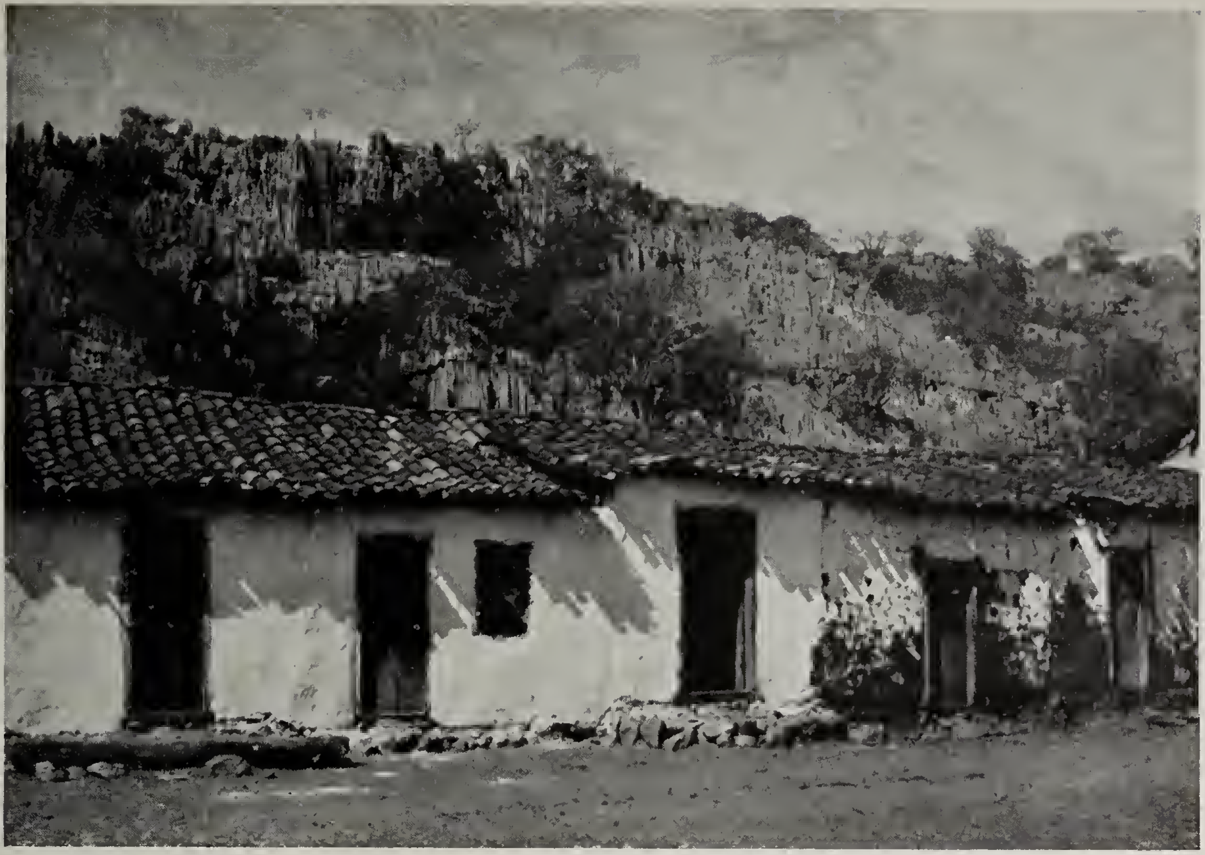

FIG. 5

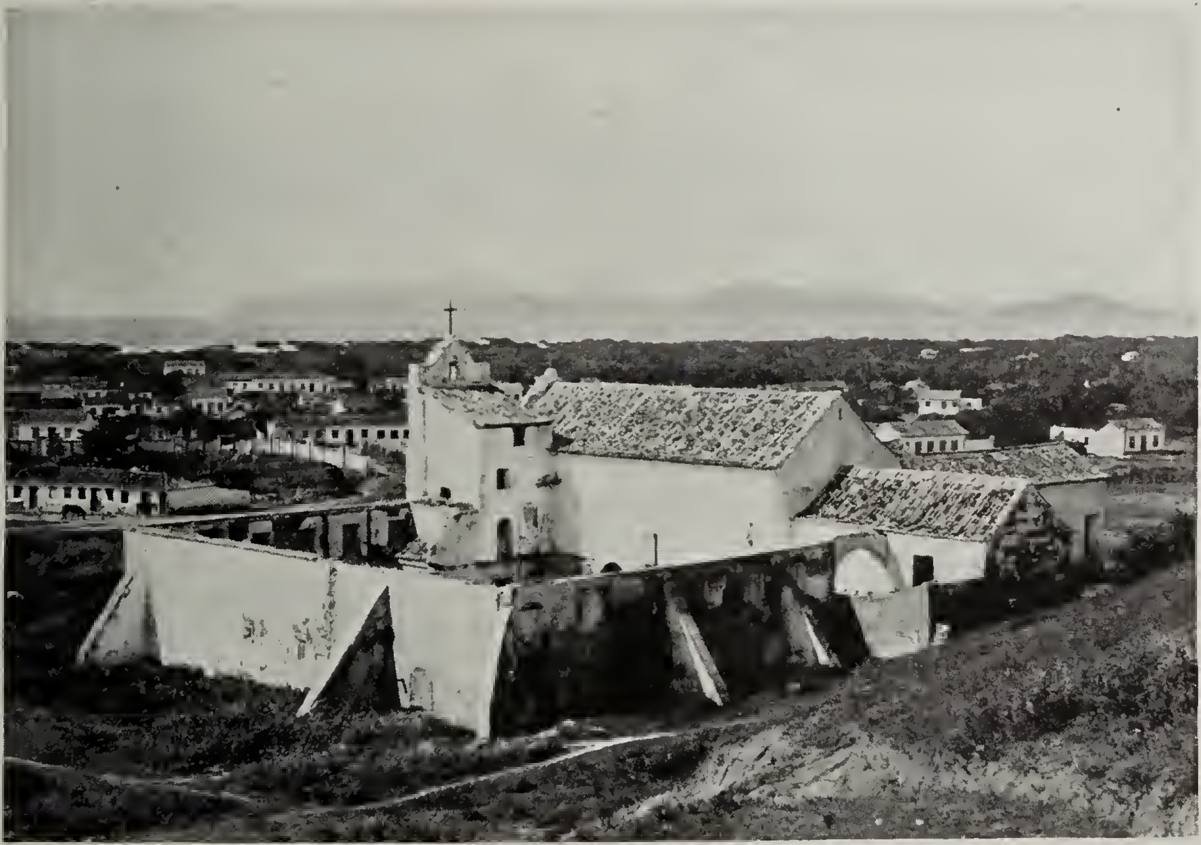

FIG. 6

FIG. 5—The mud village. Showing how the mud houses are strung end to end on either side of the village street. On the Rio São Francisco, at Bom Jesus de Lapa, Bahia.

FIG. 6—A monastery of the type described by John Mawe, built of earth tamped into a form. This is the limit of earth houses in the directions both of size and durability. Such structures have lasted over two centuries.

that 25 per cent or more of the population of the state (Minas) is profoundly afflicted or rendered useless by this scourge. It exists throughout the state of Goyaz, in vast regions of Maranhão, Piauhy, Bahia, and Matto Grosso, and in some of the counties of São Paulo. . . . Deaths by the cardiac form occur in tremendous numbers in the infected zones, individuals dying through heart failure at all ages, even in full youth. The nervous form of Chagas' disease constitutes another aspect of extraordinary social importance. It includes those humans, monstrous in mentality and physical aspect, scattered through the interior of Brazil by the tens of thousands. . . .

Curral d'el Rey, whence the disease appeared, was but a background for goiters, cripples, and idiots—a tremendous breeding ground of the terrible *barbeiro*, there in the burrows, the dens, the mud-walled houses of the old inhabitants. These destroyed and substituted by attractive and hygienic habitations, both the insect and trypanosomiasis americana disappeared in all its forms. . . .

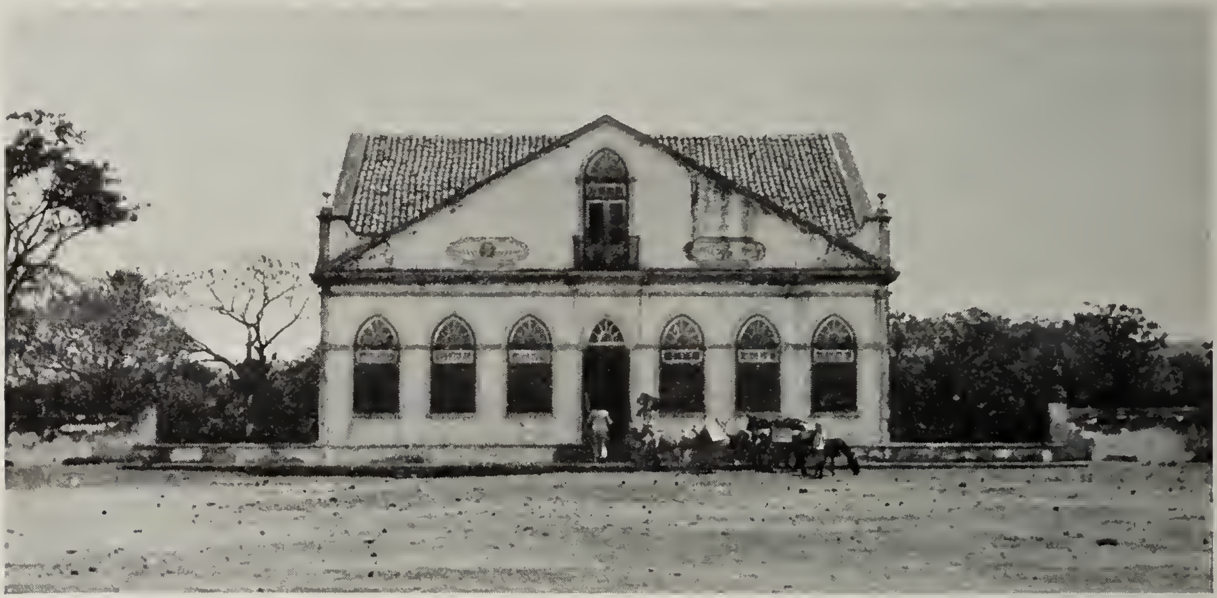

Fig. 7—One of the best types of rural brick-and-plaster houses. Verandas are conspicuous by their absence. Note the glass balls on the two corners. Although there is ample room to set the house back, it is almost always set flush with the street. Icó, Ceará.

Go to Sete Lagôas and Curvelho. In the residences of the well-to-do and those who live in houses covered with tiles, with smooth, whitewashed walls, neither the *barbeiro* nor the disease is encountered. Both are met in the suburbs where they tolerate the *cafúas*, the houses without plaster.[3]

The world of science is chiefly indebted to Dr. Carlos Chagas, the present head of Brazil's Department of Public Health, for identifying the malady with its cause. I have quoted his chief of rural sanitation thus at length because the disease is scarcely known outside of Brazil, and its cause still appreciated by few.[4]

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[3] Conferencias, Rio de Janeiro, 1919, pp. 78–83.

[4] The disease is due to a trypanosoma—*Schizotrypanum Cruzi*—carried by *Triatoma megista* (of the family Reduviidae), locally known as the *barbeiro*. The disease appears to develop under rather special conditions, and its geographical distribution is restricted. Outside of Brazil it has been reported in two localities in Venezuela, in San Salvador, and in the eastern forests of Peru bordering on Brazil. Dr. Chagas' initial discovery was made while conducting an anti-malaria campaign in construction works on the central railroad of Brazil in 1907 under orders from Dr. Oswaldo Cruz of yellow fever fame. See M. Neveu-Lemaire: Notes de géographie médicale, section "Maladie de Chagas ou schizotrypanose américaine," *La Géographie*, Vol. 35, 1921, pp. 27–35.

STONE HOUSES

What a relief it is to come upon a locality here and there where the environment has caused a departure from mud in favor of stone! Diamantina, the center of the diamond district in Minas, lies on a high range of mountains which is almost bare of building timber, and for a dozen leagues round about even such slender poles as are used in the walls of the mud house are difficult to find. There is an abundance of excellent stone in the neighborhood, however, and all the older houses were built of this material. Many fine houses of two and three stories, constructed over a century ago in the days of prosperity, still adorn the town and grow lovelier with their increasing years. Unfortunately, since the railroad has been built, the tendency has been away from stone.

Penedo, on the São Francisco River in Alagôas, is another stone town, built of the fine-grained, yellowish-colored sandstone on which the town stands. There must be others scattered here and there in this vast country, just as rare, isolated stone houses are seen—I encountered a temporary shelter of stone above timber line on the Serra do Caparaó on the boundary between Minas Geraes and Espirito Santo. But for the most part the Brazilian farmer, like the North American, shuns durable building materials as he would the plague.

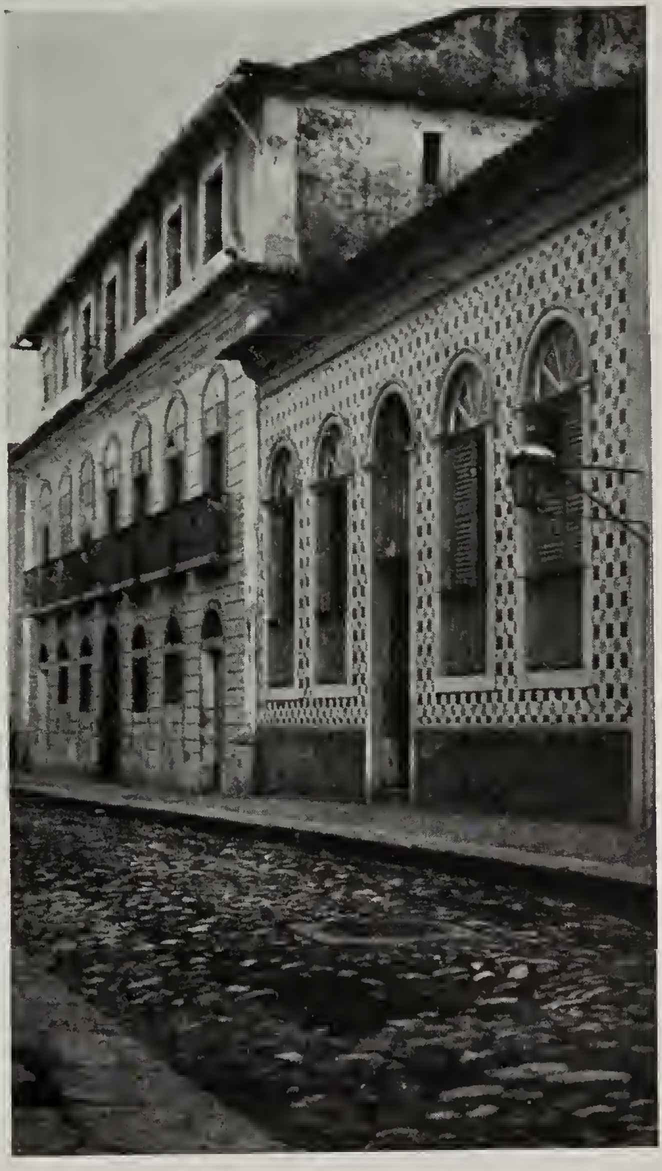

FIG. 8—Blue and white tiles used as a wall facing. The first (right) house appears to be built of pressed earth; the three-storied structure adjoining is undoubtedly of native soft brick. São Luiz, Maranhão.

WALLS OF WATTLE

Now and again brush, woven into a rude wattlework, serves for the walls of dwellings like those hastily constructed at the edge of a great American construction camp in Ceará. Although it is better suited to a dry, hot country than is the mud house, in a belt of heavy rains it shelters its inmates but indifferently. This type, wattle and thatch, is widely distributed but is not numerically important.

The Sod House

As the steppes of Russia have given birth to the *isba* built of turf, and the Great Plains of the United States to the sod house, so the pampas of Rio Grande do Sul have produced a similar hut. At rare intervals along the Uruguayan frontier, where timber is very scarce, one sees the shelter of some *gaucho* made by piling layer upon layer of sod from the plains whereon his cattle pasture. I have encountered this type nowhere else in Brazil, and it cannot be said to be at all common even in Rio Grande do Sul.

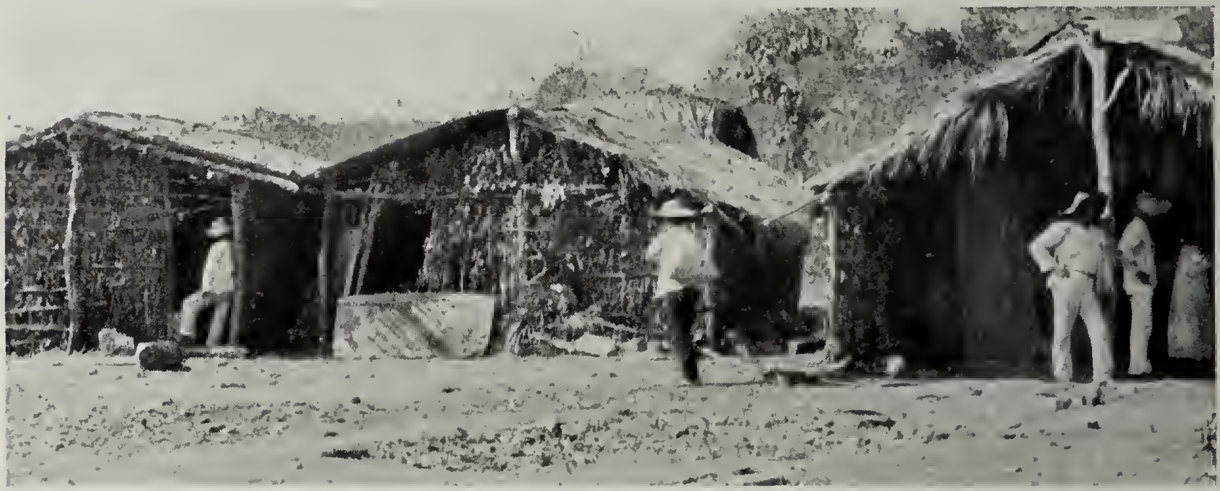

Fig. 9—The house of wattle has the advantage over the one of mud in that a space must be left between two houses of the former. On the edge of American construction camp at the Orós Dam, Ceará.

Houses of Wood

Just beyond Passo Fundo, traveling north through Rio Grande, one comes into the solid forest of Paraná pine (*Araucaria*) which clothes the plateau of Santa Catharina and Paraná. This is the region of the wooden house; and, as there are outliers of the forest along the watercourses to the southward of this point, so has the forest projected its wooden house upon the plains of Rio Grande. The sight of the first *gaucho's* cabin of slabs or boards with a shingled roof is enough to make one from the Great Lakes pinery gasp with delight. Rude, unlovely, without beauty of line or color, yet it appeals more than a palace after the monotony of mud to which we have grown accustomed, for it heralds our approach toward a forest folk who are beginning to utilize the wealth of their own environment. It is but an outpost of the lumber mills we are approaching, where there are many houses built not of slabs but of boards and siding, with trim doorways and window frames, steps of wood, verandas of wood, shingles on the roof, and sometimes even a coat of paint. If we entered, our feet would surely be greeted by boards on the floor. Our enthusiasm almost leads us to praise even the "gingerbread" embellishments produced, in Brazil as in North America, by a too facile fret saw.

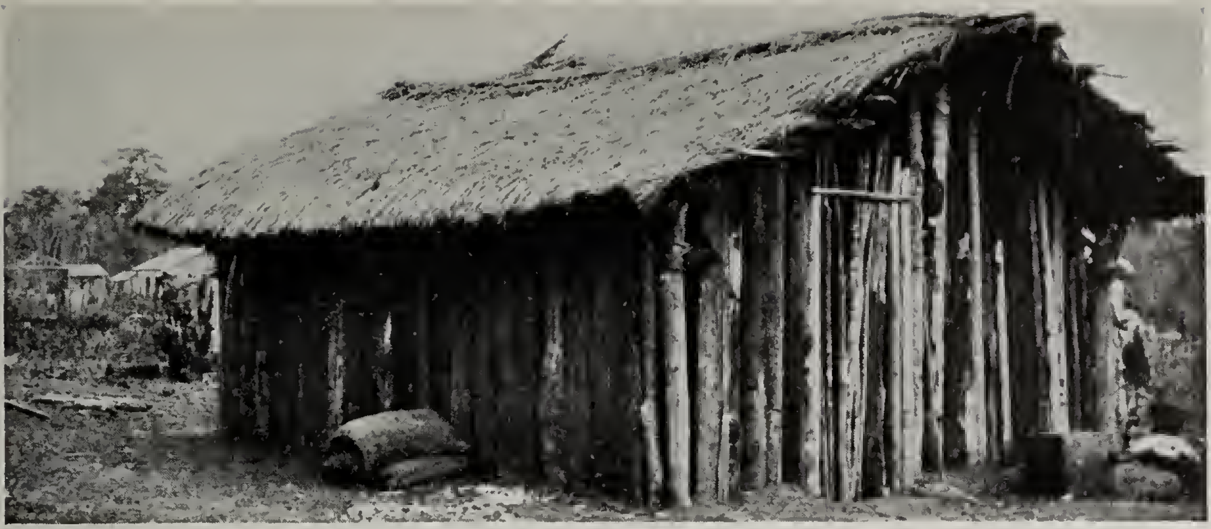

FIG. 10

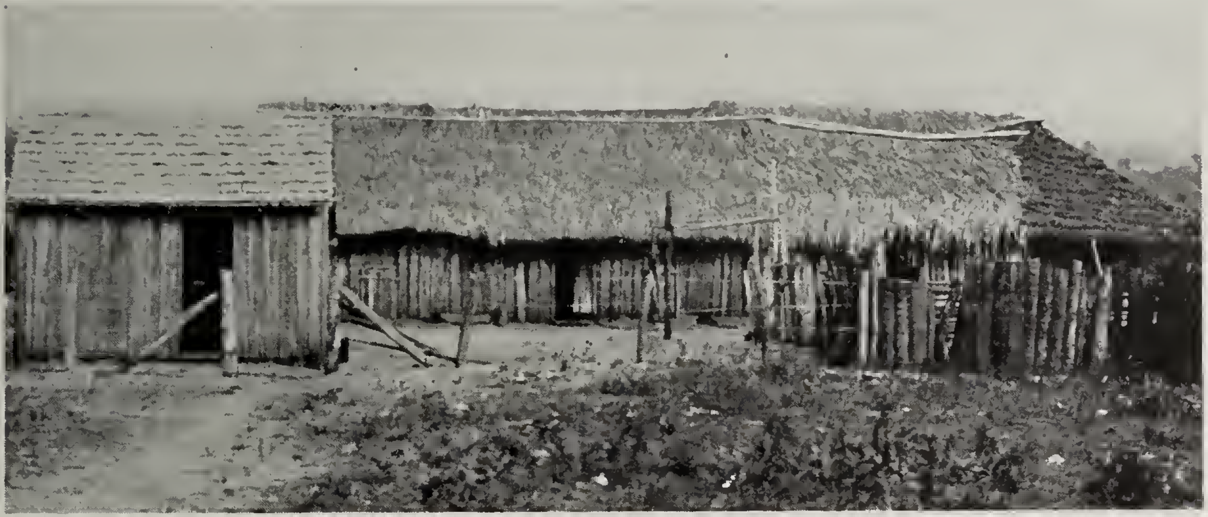

FIG. 11

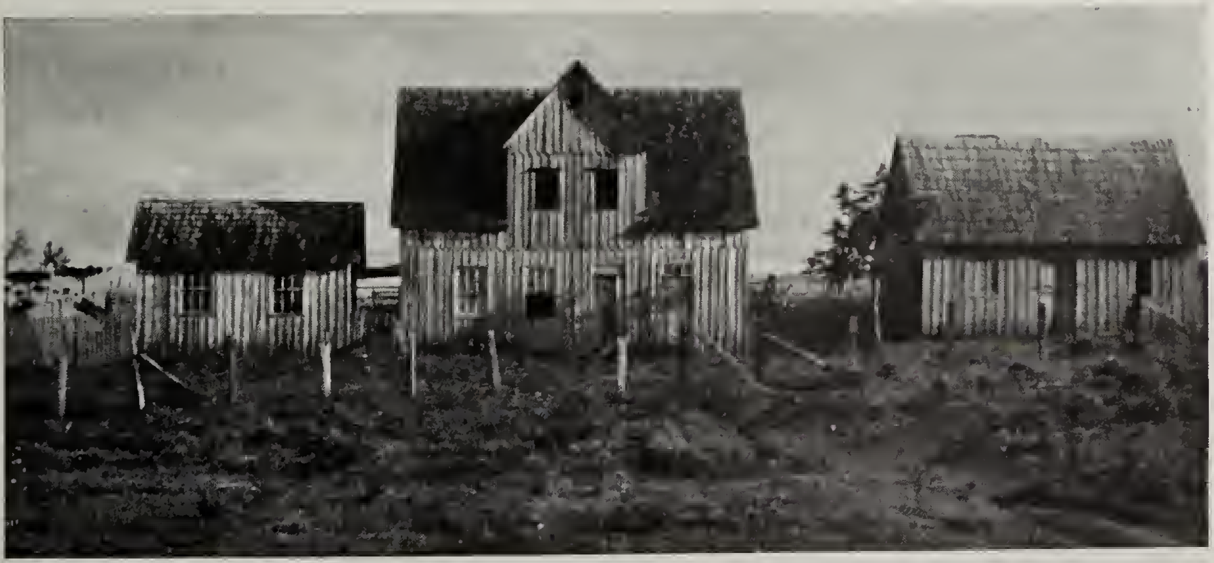

FIG. 12

FIG. 10—A wooden house whose walls are made of round uprights planted in the ground. Matto Grosso.

FIG. 11—The second step in the evolution of the wooden house is to hew a face on the upright posts (center house); the third step is the use of split "shakes" placed vertically; the fourth step is the house of sawn boards used vertically, as in the house on the left.

FIG. 12—Practically all the buildings are of wood in the Paraná pine forests in the state of Santa Catharina.

Surely the music of a straight log driven on its carriage against a rapidly revolving saw is one of the finest sounds a heavily forested country like Brazil can hear. If a tenth part of the timber which has been burned to make the coffee plantations of São Paulo, the cacao plantations of Bahia, the fattening pastures of Minas, and the partial clearings of shifting agriculture everywhere had been manufactured into cheap lumber, every mud hut in Brazil could have been banished, along with the insects that infest them, and houses of wood erected in their place.

Not only in the forest region of Santa Catharina and Paraná is the house of lumber encountered, but likewise in the neighborhood of the sawmills which have been set up along the Rio Doce in Espirito Santo. Weathered walls of unpainted boards are the rule there, as in so many North American lumber towns. And not infrequently in this valley is seen a house with walls of shakes, short boards split from the log by hand and used in the wall vertically. Out in Matto Grosso round posts set side by side are used in much the same way to form the walls of more temporary shelters.

But in three years' wandering through Brazil I have never encountered a single example of that simplest type of wood house which the straight trunks of trees have suggested to forest dwellers everywhere in Europe and North America. The superposition of logs, either in the rough or squared, notched at the corners to form the walls of a log cabin, seems inherent in the physical character of the material. But because Brazil was settled by the Portuguese instead of by forest dwellers from the north of Europe, an obvious use for down timber never impressed itself on minds filled with other traditions. The log house can probably be found in out-of-the-way German or Polish colonies; but it must be described as an infrequent phenomenon in the forest regions of Brazil.

This infrequency is less astonishing than the general disregard of bamboo, which by all the peoples from Yokohama to Singapore and the islands of the South Seas is considered the God-given building material. Logs are heavy, and an isolated settler cannot place them even with the help of his wife and children; but bamboo is the lightest of all building materials. A Filipino with his *bolo* will build a house of bamboo, frame, floor, and walls, and thatch it with *nipa* quite as rapidly as the Brazilian builds his hut of mud. At the end, the Filipino has a thing of beauty, raised off the ground, cool, dry, with a floor of half-inch strips which springs under bare feet and can be polished with a banana peel; the Brazilian an ugly, unclean hovel which he shares with death-dealing insects. Yet bamboo will grow practically everywhere in Brazil and does grow profusely in many places now but is not utilized even for fish poles.

HOUSES OF BRICK

Before we speak in praise of the brick house it is just as well to point out that there are bricks and bricks. The ordinary, soft bricks of Brazil, of the color of the clay from which they are fashioned, with rough surfaces and

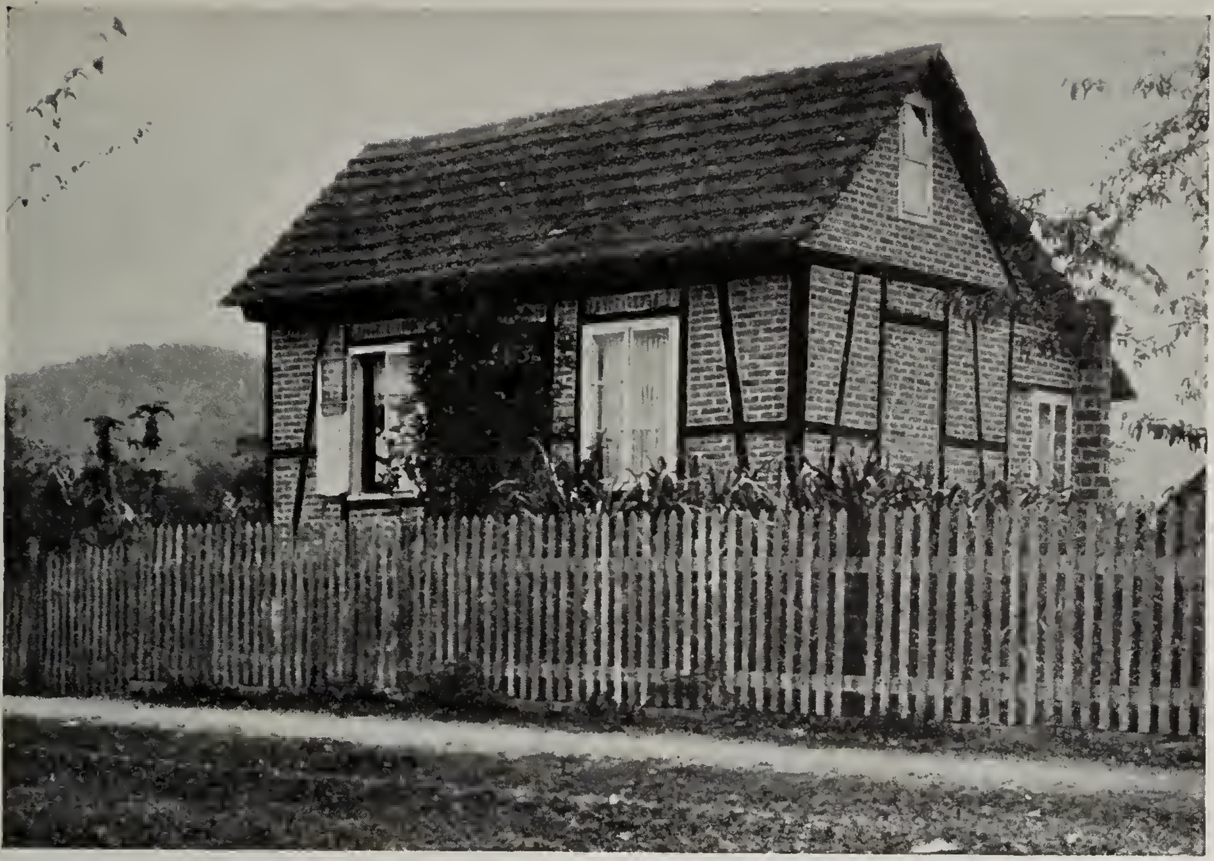

Fig. 13

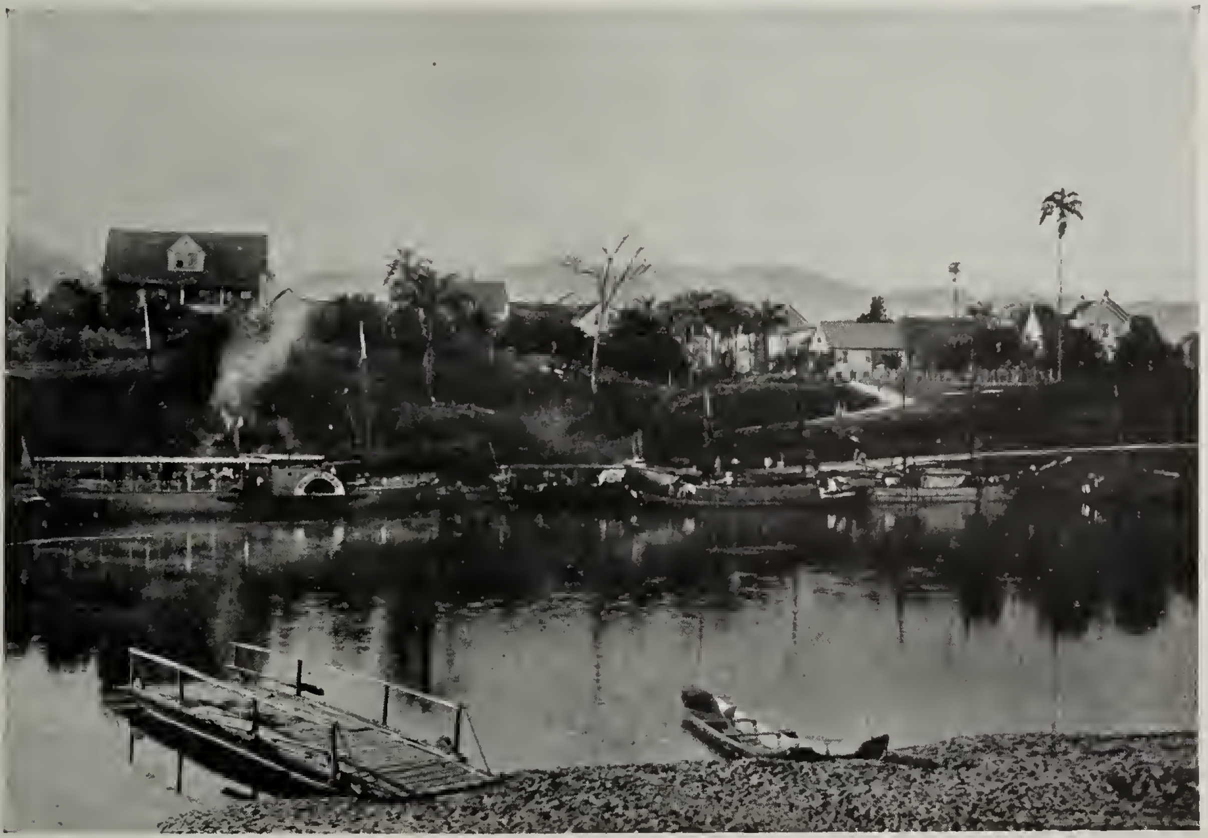

Fig. 14

Fig. 13—Typical farmhouse of the German Colonies in Santa Catharina: red brick of fine quality, timbering painted black, white sashes and door frames, and flat tiles, and note the *chimney!* It is not seen in most rural houses in Brazil.

Fig. 14—The town of Blumenau, a German settlement in Santa Catharina.

irregular edges, are only one degree better than the clay which is plastered into the squares of the mud house and allowed to dry in place. Like adobe, they always have to be disguised with a daub of clay or stucco or a facing of tiles; and it is easy to pass them by without distinguishing between the brick house and the better class of earth structures similarly finished.

When the traveler enters the German colonies in Santa Catharina it is almost as if he were transported to another land. What a difference the standards of a more exacting civilization have wrought! These industrious peasants from the north of Europe started with the same materials that went into the mud hut—timber and clay, but the issue bears no faintest resemblance.[5] In the two thriving *municipios* of Joinville and Blumenau the timber is framed in attractive patterns that reveal structure and strength and adorn the exterior; the clay has been subjected to a mold and fire, nothing more complicated. Yet in the process it has taken on a gorgeous red hue together with durability and a hardness which no *barbeiro* can penetrate.

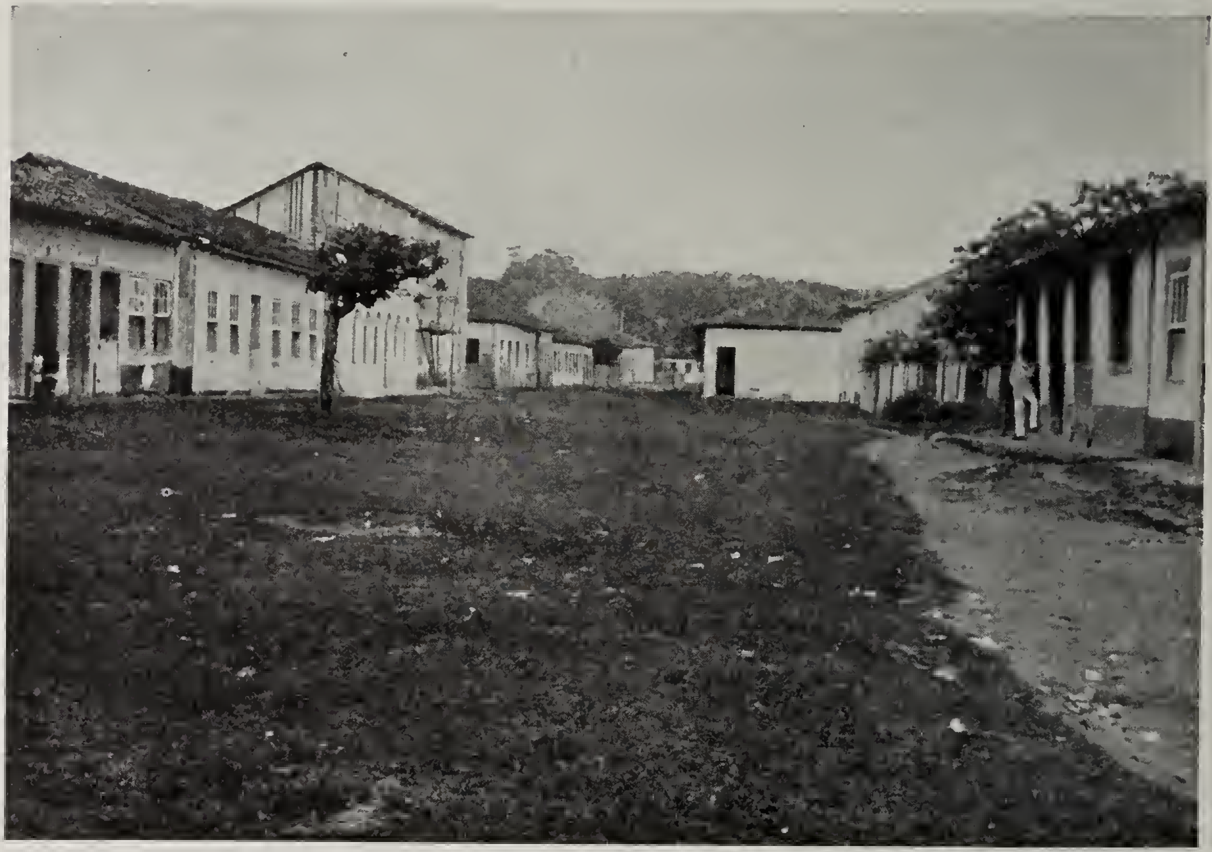

FIG. 15—Santa Cruz, Espirito Santo. Grass-grown main street, path trodden by bare feet at right, whitewashed mud houses built end to end and placed flush with the street. This is the type of thousands of little villages in rural Brazil.

The tiles which cover it are molded flat, under pressure, giving as fine a roofing as the world affords. With a chimney to carry off the smoke of the kitchen fire, dark paint on the timbering, and a bit of bright color on window and door frames—the result, when set in a well-kept flower garden, is as attractive and substantial a type of farmhouse as can be found throughout Europe. I know no farming district in the United States where the houses are so uniformly pleasing as well as appropriate.

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[5] It is worth while to quote from Pierre Denis' "Brazil" (p. 299) on this point. "The Brazilian population, to judge from its dwellings, camps upon the land instead of residing on it. But the German colonists have brought to Brazil the love of a comfortable house, and each of their houses is a true home."

Brazil need look no further for one possible solution of its rural housing problem. The materials are found throughout the length and breadth of the land, and these hardworking Brazilians of Blumenau have shown splendidly how to use them. Indeed, the cities of Brazil might take a lesson from the farmers of Santa Catharina. The buildings which are being constructed today of soft bricks covered with stucco and a wash of color, however attractive when new, certainly will not bear comparison with the brick edifices of Blumenau half a century from now.

Such are Brazilian rural dwellings. Two types of habitations common in certain parts of the world are almost nonexistent: there is no cave-dwelling population in Brazil; and, aside from a few wandering gypsies and *vaqueiros* on the road with cattle, there are no tent dwellers.

The Rural Village

Lack of durability was the overwhelming impression which Spix and Martius had of the villages of rural Brazil a century ago at the end of the first extensive journey made in the interior by European scientists. Their picture of an average village in interior Brazil is as accurate in 1922 as it was in 1822. One entirely misses the appearance of comfort and solidity calculated for long duration which distinguishes European dwellings.

"Like house, like village." If the human habitation is frail and low, it is difficult for the village to appear anything but ephemeral and mean. The custom of stringing one-storied mud houses end to end along both sides of a narrow street simply magnifies ugliness many fold. Why do we find such crowding in the country where of all spots on the globe there is land enough for every one and to spare? It is a characteristic of the Mediterranean type of village described by Brunhes:

> Almost all the Mediterranean peoples, preëminently "urban," have grouped themselves in settlements with houses closely crowded together, so closely that they have the appearance of small cities even when they are only simple villages. A life concentrated around the public square . . . , around the bastion or stronghold, the temple or the church, is preëminently a life of house close against house.[6]

Here again, tradition is fortified by environment. Brazil is as yet so underpopulated, so much of life is spent in appalling solitudes, in traversing almost uninhabited *campos* and *caatingas* for weeks on end, in pushing a canoe through watery wastes where the sun seldom enters and men chant aloud as they paddle to lighten the oppressive weight of the silence. The village was built for companionship, for human warmth.

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[6] Jean Brunhes: Human Geography, transl. by T. C. LeCompte, edit. by Isaiah Bowman and R. E. Dodge, Chicago and New York, 1920, p. 503.

"Why set my house in the middle of a garden when I can build so near my friend, João, that I can counsel with him about cattle and crops without getting out of my hammock?

"Why set my house back from the street where *tropas* pass with their tinkling bells, and the chant of the *vaqueiro* precedes the rumble of hoofs of the *boiada?*

"God knows there is enough of silence and loneliness in the *sertão!*"

THE ORIGIN AND GROWTH OF PARIS

By Lucien Gallois
University of Paris

Paris makes its earliest appearance in history a half century before the Christian era during the Roman conquest of Gaul. It is in the *De bello Gallico* that Caesar makes the first reference to the Parisii and their capital Lutetia.

The Parisii were a small tribe whose forest-encircled domain was of much less extent than that of their powerful neighbors of Chartres, Beauvais, Sens, or Rheims. As to Lutetia, the capital, it was confined to an island in the Seine. Certainly no one could then have foreseen that it would become one of the world's great cities.

It has been said, it is true, that Paris occupies a situation that was destined sooner or later to give birth to a great town. Paris has been called the "attractive pole of France." It is always easy to predict after the event. A town, however, is the work of man rather than of nature. That the position of Paris offers advantages is easily demonstrated. Yet at the same time historical events and economic facts have had their influence on its development. Let us study first the physical *milieu* in which Paris has grown, the surrounding region, and the site of the town itself and then follow its destinies across twenty centuries of history to the present day.

The Parisian Region

Paris occupies the center of a great natural region appropriately known as the Paris basin. This region is surrounded by uplands and highlands of moderate elevation—the Ardennes to the north, the Vosges to the east, the Central Massif to the south, the hills of Normandy to the west. Rivers converge towards the center of the vast basin-shaped hollow. Even the Loire trends in this direction as far as Orléans. Here, consequent on a movement of depression in late geological time, the Loire makes an abrupt turn towards the west. But though there is no connecting valley the Paris basin is only separated from the Loire at Orléans by an almost level plateau which offers no obstacle to communications. The lines of concentric heights which rise to the east of the basin are all breached by rivers, and along them go the roads.[1] In all parts of the basin, by valley or plateau, roads and subsequently railways have been constructed with ease and a minimum of grade that permits most economical conditions of transportation.

Furthermore, the Paris basin has easy communications with neighboring

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[1] For a brief study of the Paris basin I cannot do better than recommend to the reader Professor W. M. Davis' little book "A Handbook of Northern France," Cambridge, Mass., 1918.

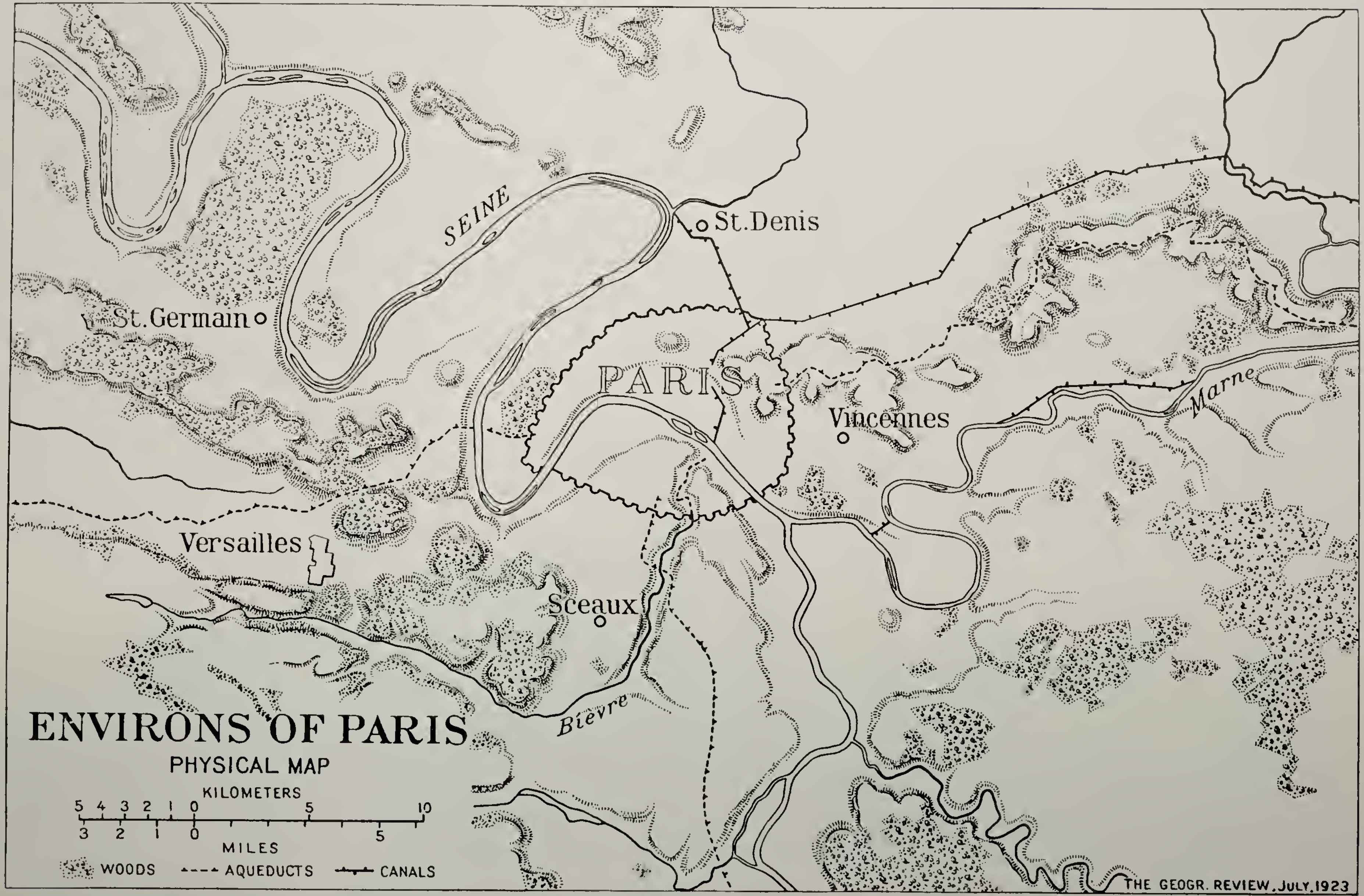

Fig. 1—Physical map of the surroundings of Paris. Scale approximately 1: 333,000.

regions. No barrier separates it from Belgium to the north or Alsace and the valley of the Rhine to the east; for the mountainous massif of the Hautes-Vosges is easily turned by the depression inappropriately termed the "col" of Saverne on the north, and on the south by the broad gap of Belfort appropriately known as the Burgundian gate which separates the Vosges from the Jura. Towards the Saône-Rhone valley there is no important obstacle, connection being readily made by the gap of Langres or more directly across the heights above Dijon where a single tunnel gives access to the railway. As has been said, communication is easy with the valley of the Loire whence one passes by the broad saddle of Poitou into the valley of the Garonne.

So facile are these connections that they have been readily extended by the canals that now link up the rivers, Seine and Scheldt by the Oise, Seine and Rhine by the Marne, Seine and Saône, Seine and Loire. Paris has thus become the center of a great network of waterways, roads, and railways, a system perfectly adapted to the natural conditions. But this system has only developed as the city has grown. In the first instance there had to arise the need of a convergence of roads at some specific point in the region. This is clearly shown by the course of historical events. When Gaul was a dependency of Rome it was on Lyons that the network of routes converged, because Lyons, in easy communication with Italy, was the point of support for Roman power in Gaul and, as it were, the capital of the country.

The convergence of valleys and rivers is the most salient feature of the geography of the Paris basin. The Marne joins the Seine at the very gates of Paris; some 20 kilometers to the west is the confluence of the Oise. But not only this: due weight must also be given to the navigability of these streams of tranquil and steady flow. That navigation on the Seine and its tributaries commenced at an early date is certain. Caesar speaks of the numerous boats encountered on the Seine in the neighborhood of Paris; and the geographer Strabo, a century after the conquest, mentions the importance of the waterways which crossed Gaul by the Rhone, Saône, and, after a short interruption, by the Seine or Loire.

Between the rivers which converge on Paris lie interstream areas of great fertility. Covered in large part by loams they are grain lands *par excellence.* At a time when a region had to be largely self-supporting there was sustenance here for a numerous population. Paris was fed chiefly on the wheat grown in the Île de France, the region between the Seine and the Oise which first bore this name. By way of Rouen came salt from the seaboard, by the Yonne wood was floated down from the forests of Morvan. But these advantages must not be exaggerated. Many towns, Berlin for example, have flourished in regions impoverished as regards natural resources. At the same time to have at hand all the prime necessities of life was an evident cause of prosperity, especially in ancient times. Productivity of the soil was also favored by a climate generally mild and with regularly distributed and sufficient rains. Furthermore, the summers of this tempered climate were yet warm enough for grapes and various other fruits to ripen. Once all the neighboring hillsides were clad with vineyards. They only disappeared when improved transport permitted the sale of wines from the Midi at a low price.

Another factor which, while not indispensable, yet aided the growth and at the same time the adornment of the town was the presence of good building materials. From the neighborhood of Paris is quarried a very fine limestone easy to work and well adapted to sculpture, which has served in the building of the beautiful churches of the Île de France and the greater number of the monuments of Paris. Certainly the existence of such material has not been without influence on the precocious flowering of architectural art in the Parisian region. This limestone has long been quarried in Paris itself, on the left bank of the Seine. In certain sections the course of the ancient workings may be traced by subsidences of the ground to which they have given rise in the past and occasionally cause even now. Since the end of the eighteenth century a special engineering service has been engaged in making the area secure and has drawn up a plan of subterranean Paris. These abandoned galleries are often known as the Catacombs, because for the last century skeletal remains from the old Parisian cemeteries have been deposited therein.

Another building material occurring in abundance is gypsum, quarried on the slopes of the hills to the north of Paris up to the city itself. At an early date gypsum was employed in the manufacture of the plaster so much used throughout the Parisian region. Mention should also be made of the clay which outcrops in many places and is used in pottery and tile making. On the site of the old tile works next the Louvre the palace of the Tuileries, now destroyed, was erected. Once again, however, we must insist that it would be puerile to try to explain Paris by the abundance of building materials; but that fact has at least contributed to give the town its physiognomy and its architectural aspect.

The Site of Paris

But all this, one may say, applies to the region of which Paris is the center and is not peculiar to the particular corner of earth on which Paris arose. Why was this particular spot chosen, and not a site farther upstream or downstream? Why on the Seine and not on the Marne or the Oise? Or more exactly why, among the several settlements that existed on the banks of these rivers, Meaux on the Marne, Melun and Corbeil and Poissy on the Seine, Pontoise on the Oise, has Paris drawn to itself a great population while these other places have only risen to the rank of small towns? In answering this question it is not the Paris of today that we must consider nor even the town when it had already grown to a recognizable aspect, but the humble collection of huts that was its origin. The site of the primitive settlement, as it has been reconstructed by the aid of patient researches, must be examined more closely.

Paris is situated at a broadening of the valley of the Seine, a place where the river runs over softer rocks than above or below and thus has eroded them more easily. To the south, on the left bank, fronting the Île de la Cité is the hill to which has been given the rather ambitious name of Montagne Ste. Geneviève, the edge of the plateau in which the valley has been cut. But to the north, or on the right bank, there remain only fragments. One of these is Montmartre, an isolated hill rising to an elevation of 125 meters, or 100 meters above the level of the Seine; farther east and stretching to the Marne are more extensive fragments, the heights of Ménilmontant and of Belleville. The two broad gateways that open one side and the other from Montmartre furnish an easy passage towards the north.

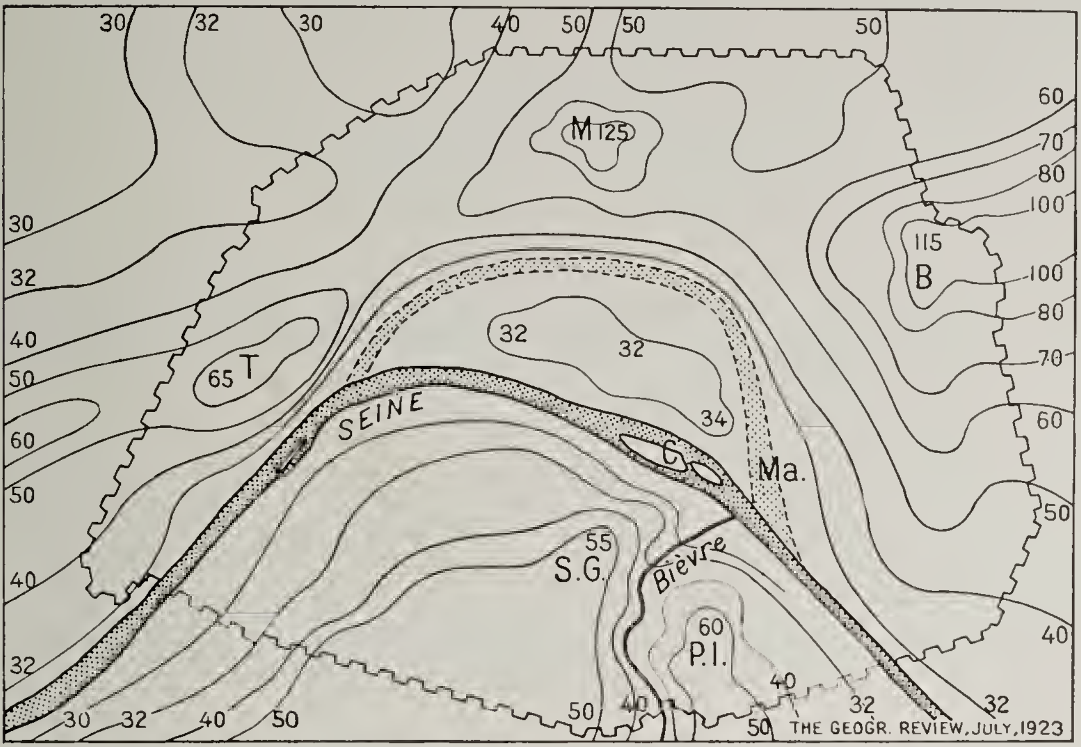

FIG. 2—Topographic relief of Paris, altitudes in meters. Former arm of the Seine in dashed lines. B, Belleville; C, Cité; M, Montmartre; Ma., Marais; P. I., Place d'Italie; S. G., Mont. Ste. Geneviève; T, Trocadéro.

Obviously this enlargement of the valley offers a site favorable to the establishment of a large town. Furthermore, there is a marked diminution of the river gradient in the neighborhood of Paris where the Seine is not more than 26 meters in mean elevation above sea level. This is the reason for the great, symmetrical meanders which the river describes in its course below the city. Decrease of gradient and slackening of the current naturally caused deposition of alluvial material brought from upstream, especially of the granitic sands brought from Morvan by the Yonne. Thus are explained the islands which formerly encumbered the bed of the river. Only two of them remain today, the Île de la Cité and immediately upstream from it the Île Saint Louis. The others were attached to the mainland in the nineteenth century.[2] These low islands were constantly menaced by inundation from the river floods. The Cité was then also much lower than it now is and was not of course embanked by quays as it is today. Upstream and down the low, indefinite banks were cut in places by side channels. One of these arms on the left bank opposite the site of the Louvre enclosed a more stable piece of ground where today stands the church of St. Germain des Prés.

A topographic map of the reconstructed site reveals the existence of an old channel to the north of the present bed at some distance from the foot of the hills of Ménilmontant and Montmartre. This old arm describes a curve which the river is no longer able to follow. Its course is still clearly discernible from the vicinity of the Place de la Bastille to the foot of the Trocadéro hill. Several times during great floods the Seine has just failed to return to this old channel. It was indeed invaded to some extent by infiltering waters during the flood of 1910. Historical documents confirm what topography teaches. In the Middle Ages there still existed a marshy belt stretching upstream from the Place de la Bastille and occupying the quarter still known as the Marais. This marsh area was not drained until the twelfth century, before which time the roads leaving Paris in north, northeast, and northwesterly directions crossed it by bridges. All the low area to the north of the Seine offered little attraction to human settlement. It took centuries for Paris to grow in this direction.

But to return to our question, why was the settlement of Lutetia founded at this point in an island of the Seine? Without doubt because of the comparatively easy river crossing here afforded. For travelers coming from the south the Montagne Ste. Geneviève formed a sort of elevated causeway leading down towards the Seine. At this place the ground was firmer than immediately above, about the confluence of the Bièvre, or below, in the meadows of St. Germain des Prés. After the island had been crossed, the road could be taken up again on the sandy bluffs where are now the church of St. Gervais and the tower of St. Jacques. A little island facilitating a river crossing—there is the humble origin of the hamlet that became Paris. At first it was nothing more than a settlement of fishers and boatmen. But the site had sufficient attractions to fix there a small nucleus. Other advantages appeared only later with the expanding horizon of the town. And these advantages were only attained by conquest. The wooded plateaus had to be cleared and cultivation started; the marshy soil of the right bank had to be drained; and later, roads, railroads, and canals had to be built. It was also necessary to improve navigation on the rivers, without doubt one of the greatest natural resources of the early settlement but not adapted to the demands of modern navigation.

It is clearly seen from such an example as this, that nature merely furnishes man with possibilities. He must put them to profit and adapt them to his use in the face of events of which he is not always the master. This will be seen still better in the following brief glance at the history of Paris.

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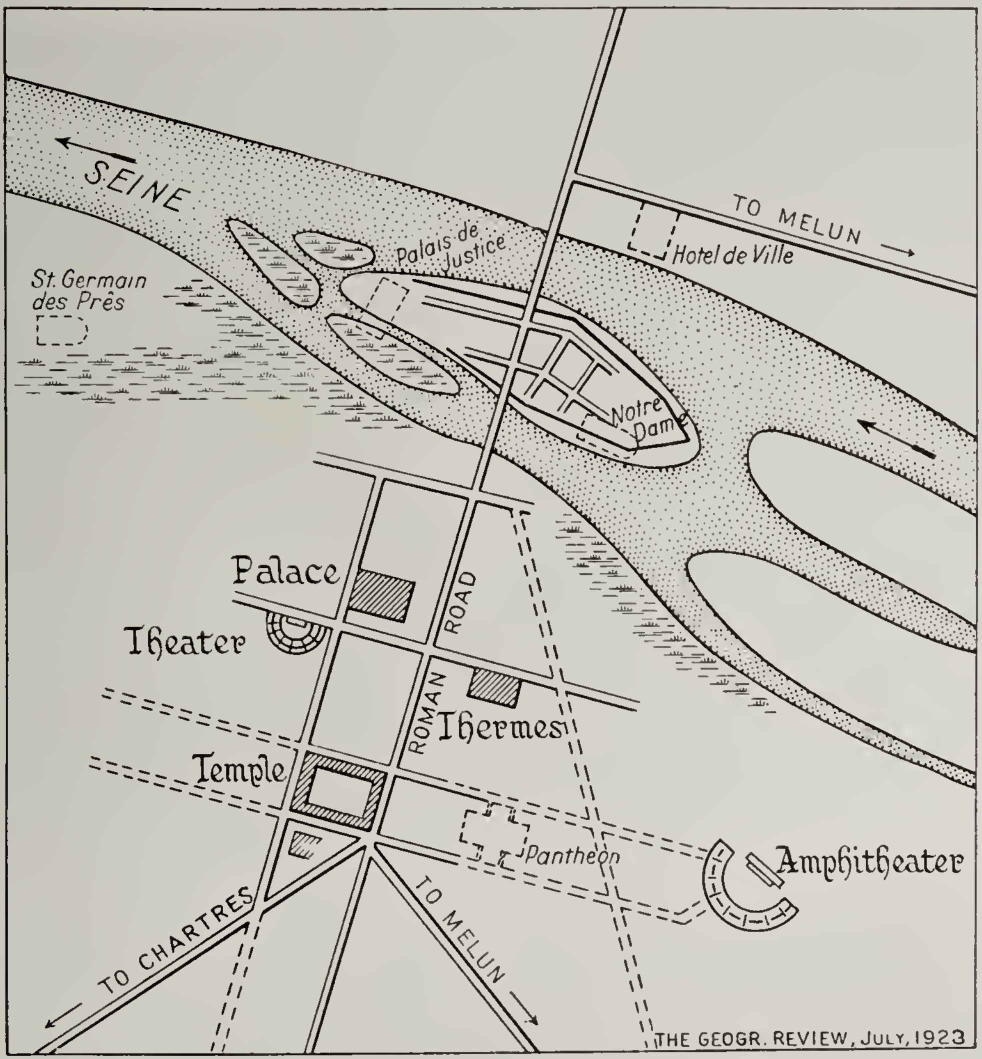
[2] There is today a third island, the Île aux Cygnes, on which has been erected a reduced copy of the Statue of Liberty at the entrance to the port of New York. But this is an artificial island.

Gallic and Gallo-Roman Paris

On the eve of the Roman conquest the little settlement of Lutetia had already achieved a certain degree of importance, for it was the chief town of the Parisii. We know from Caesar that two bridges connected it with the two banks and that these bridges were destroyed by the Gauls to impede the passage of the invading Roman army encamped on the bank of the river.



THE GEOGR. REVIEW, JULY, 1923

FIG. 3—Plan of Gallo-Roman Paris after F.-G. de Pachtère (Paris à l'époque gallo-romaine, Histoire générale de Paris, Coll. de Documents publiée sous les auspices de l'édilité parisienne, Paris, 1912). For purposes of orientation some modern sites have been shown with names in hair-line italics.

The Parisii, like other Gallic tribes, did not long hold enmity against their conquerors. They quickly submitted to the Roman aegis and the peace which it assured. It was thus that Gaul was opened to Mediterranean civilization and received the Latin impress. One knows with what readiness the Gauls gave up their Celtic speech and adopted the Latin tongue from which modern French has descended.

A Roman town arose opposite the Cité on the hill on the left bank of the river. It had all the usual buildings to be found in Roman or Romanized towns, including a theater, arenas, and baths. Water for the baths was brought from the neighboring plateaus by an aqueduct which crossed the valley of the Bièvre. During the first three centuries of our era the Roman town on the hill must have been a pleasant place with its villas enveloped in gardens and vineyards. A Roman road, doubtless replacing an older Gallic track, crossed it coming from the south and led to the bridge to the Cité. Another bridge carried it to the right bank whence it divided, one branch going upstream, another down. Two of our modern streets still mark its route, rue St. Jacques on the left bank, rue St. Martin on the right. They are the most ancient streets of Paris.

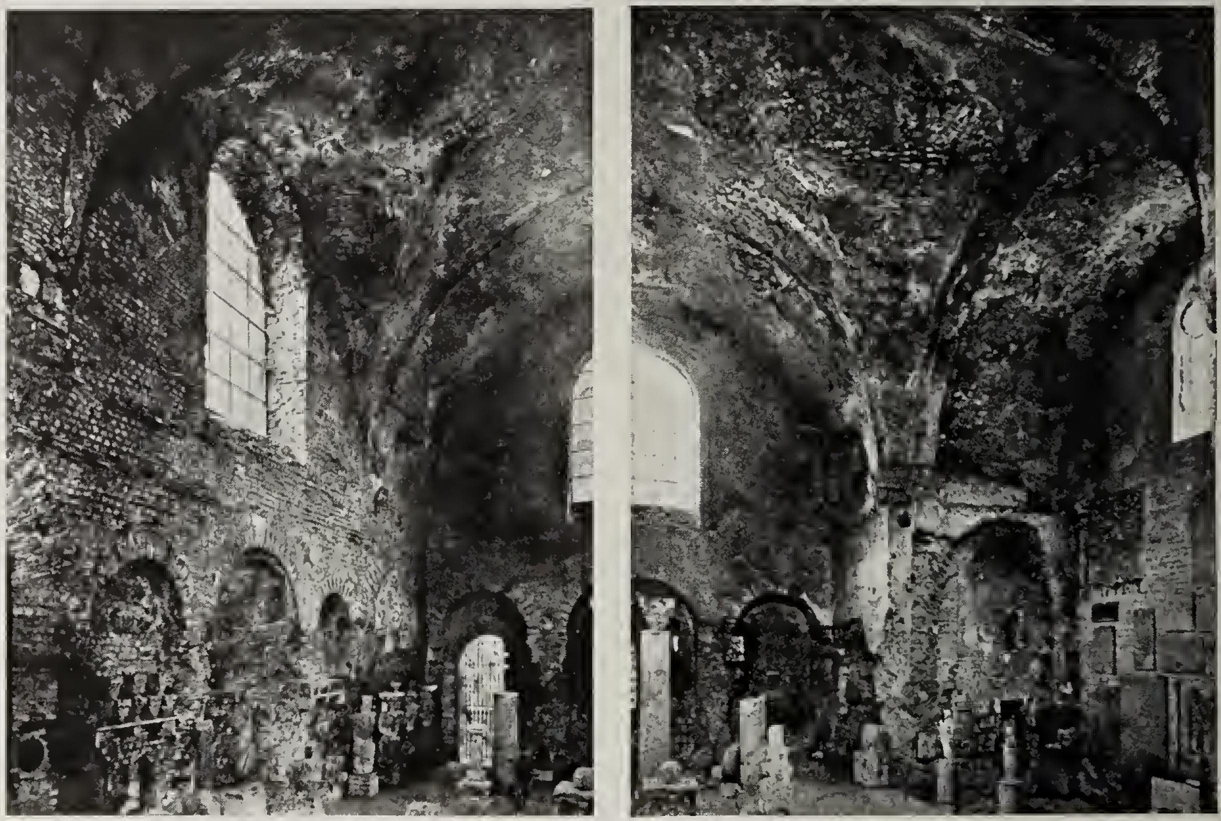


Fig. 4 Fig. 5

Figs. 4 and 5—Remains of Gallo-Roman Paris. The great hall of the so-called Palais des Thermes now included within the Musée de Cluny. After a photograph from F.-G. de Pachtère (see Fig. 3).

Of Gallo-Roman Paris there remain today only the buildings adjacent to the Cluny Museum, incorrectly known as the Thermes, and the recently excavated arenas. It must be admitted that they are in no wise comparable to the fine ruins of Arles or Nîmes. Roman Lutetia was certainly not a great city. From this period there dates an interesting inscription, the oldest that has been excavated in Paris. It occurs on a little monument erected to Jupiter in the reign of the Emperor Tiberius by the corporation of

Parisian boatmen. Tiberius reigned in the first century of the Christian era, but the corporation was doubtless older. In time it became one of the richest corporations of the city, and from it developed the municipality.

Barbarian invasions at the end of the third century destroyed this luxurious town on the left bank of the Seine. With the débris of its buildings the Parisii for the first time surrounded their island with defensive walls. A Roman garrison was stationed there, and military chiefs were in residence. One of them, Julian, was there proclaimed Emperor by his soldiery. Of the little town he has left a description which testifies to the charm it had for him: "I was," he says, "in winter quarters in my dear Lutetia. It is quite a small island, enclosed within encircling ramparts and approached only by two wooden bridges. The river which surrounds it is tranquil and steady-flowing. It is agreeable to contemplate its limpid waters, which, furthermore, are good for drinking and are used for this purpose by the inhabitants. The winter is not severe; the climate is sufficiently mild for the cultivation of fine vines and even figs, though these latter must be protected by straw coverings against the winter cold." This last curious detail is perfectly exact.

But the Roman forces could not resist the pressure of the barbarians. Paris ultimately fell into their hands, though how or when is not known. On the other hand Christianity was introduced, and its impress replaced that of Rome. A new epoch commenced with the fifth century. The name Lutetia disappeared and was succeeded by that of the people who occupied it.

Paris at the Beginning of the Middle Ages

At the beginning of the sixth century one of the Frankish chiefs, Clovis, had attained practical mastery over all Gaul. Under the influence of his wife Clotilde he was converted to Christianity, less however by conviction than by the hope of advantages to be gained from the favor of the bishops. In the last years of his life he installed himself in Paris, where he could readily keep watch over conquered provinces north and south of the Seine. There he died and was buried, and his wife Clotilde also, in the church he had built on the summit of Mont Ste. Geneviève.

This pious foundation was the forerunner of many similar ones, churches and abbeys. The best known are those of St. Germain des Prés, on the left bank of the Seine, and St. Denis, on the right bank but in the present suburb of that name. St. Denis dates from the seventh century and later became the burial place of the kings of France. Round these religious edifices and under their protection settlers established themselves and took up cultivation. Both churches thus became the center of distinct agglomerations which in time expanded and approached until now their union is complete. One of the Frankish kings of the seventh century established for the benefit of the abbey of St. Denis a great annual market which acquired a fame similar to that of the celebrated fairs of Champagne. It was thus that Paris benefited from its facilities of access.

But all this prosperity was threatened in the ninth century by a return of barbarism. Northern pirates coming by sea arrived at the mouth of the Seine. They seized and sacked Rouen, whence their flotillas ascended the river. Everywhere the terror-stricken populace fled before them. The monasteries hastened to carry away to safety the relics of the saints. For a time the Normans were halted before Paris by a payment of gold, but later they returned and took the town. When they left, the inhabitants rebuilt their walls and thirty years later victoriously resisted another assault. But all the surrounding country was devastated, and its inhabitants were forced to seek refuge within the town.

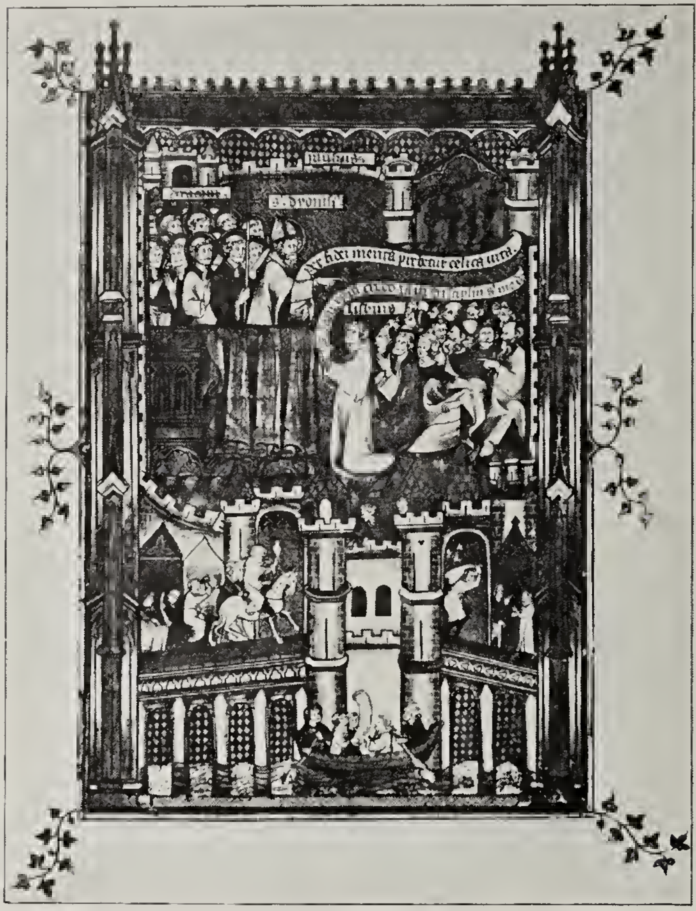


Fig. 6—The Pont au Change. After a miniature in a manuscript of the Légende de Saint Denis, commenced in the fourteenth century (Bibliothèque Nationale de Paris, fonds français, 2090). In the middle of the bridge a fortified gate; on the bridge, passers-by and shops. Above, are presentation of Saint Denis preaching.

We are now in the tenth century, and the primacy of Paris is not yet established. But we are on the eve of an event of great consequence for the town; the ascent of the Capet princes to the throne of France.

Paris, Capital of France

The treaty of Verdun in 843 had put to an end Charlemagne's attempt to restore the Roman Empire of the west. By this treaty a threefold division of territory was made, the westernmost portion becoming the kingdom of the Franks or France. But the authority of these first kings of France was precarious. The feudal régime had almost entirely destroyed any form of centralization. Every baron was to all intents and purposes independent in his own domain. For a century the Carlovingians reigned ingloriously enough; then (987) the feudal chiefs chose for king the scion of another house, Hugh Capet, whose father and grandfather had distinguished themselves in the struggles with the Normans. These Capetians had their own domain, which extended from the Loire to the north of Paris. But, contrary to the usual belief, they had only a nominal hold over Paris, where they rarely resided, although they had a palace at the western end of the Cité on the site of the Palais de Justice. The true master of Paris was the bishop, who held the fief of the County of Paris. It took a century and a half for the Capetian kings to establish their authority in the region, and it was only at the commencement of the twelfth century that Paris became the real capital of the kingdom. The Capet kings had made France. Round their own domain, patiently during centuries they had consolidated the French provinces, united northern and southern France, made their authority everywhere respected, and extended their government. This must all be recognized if one is to understand the importance which Paris assumed in the kingdom. It grew as the royal authority grew.

We have enough contemporary documents to furnish a picture of this Paris of the twelfth century. The real city is still that of the Cité with its narrow streets, its numerous churches, its cathedral of Notre Dame, the building of which was begun in the second half of the century, and in its vicinity the palace of the bishops, the dwelling of the priests, the cloister of Notre Dame, already famous for its schools and early ancestor of the University of Paris.

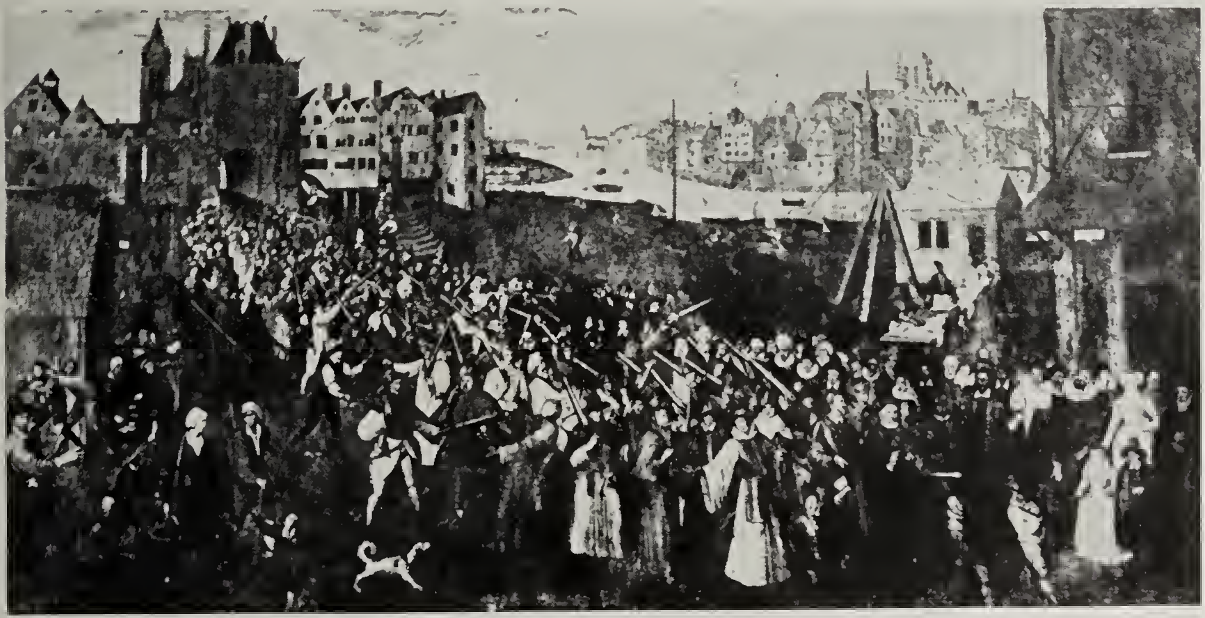


Fig. 7—The Place de Grève and the old Hôtel de Ville (Arcade St. Jean) to the left. Beyond the Seine is the Île de la Cité. The scene represents a procession of monks and soldiers at the time of the League (Catholic against the Huguenots). From a painting by Porbus (sixteenth century) in the Château de Valençay.

Still only two bridges connected the Cité with the river banks; but that to the right bank had been replaced by one a little farther downstream opposite the road leading to St. Denis (present rue St. Denis). The bridges were the scene of great animation, lined as they were with the houses and shops of merchants, while below and almost obstructing the arches were water mills or fish ponds. The right bank where the boats anchored carried the bulk of the traffic, and here was established a market the site of which is still occupied by the Halles Centrales. It was now on this side that Paris grew. But there were still many empty spaces and patches of cultivated land. The left bank was less occupied. In the midst of gardens and vineyards were several churches around which houses had grouped themselves.

Paris was becoming a great city. Its population—of which, however, it is impossible to give a figure—must have been large for the time. It included nobility, royal officials, clergy, artisans, merchants, tillers of the soil, and vinegrowers; and one must not forget the students gathered round the schools of Notre Dame, some of whom even then came from distant countries. Paris of the twelfth century was becoming a center of civilization.

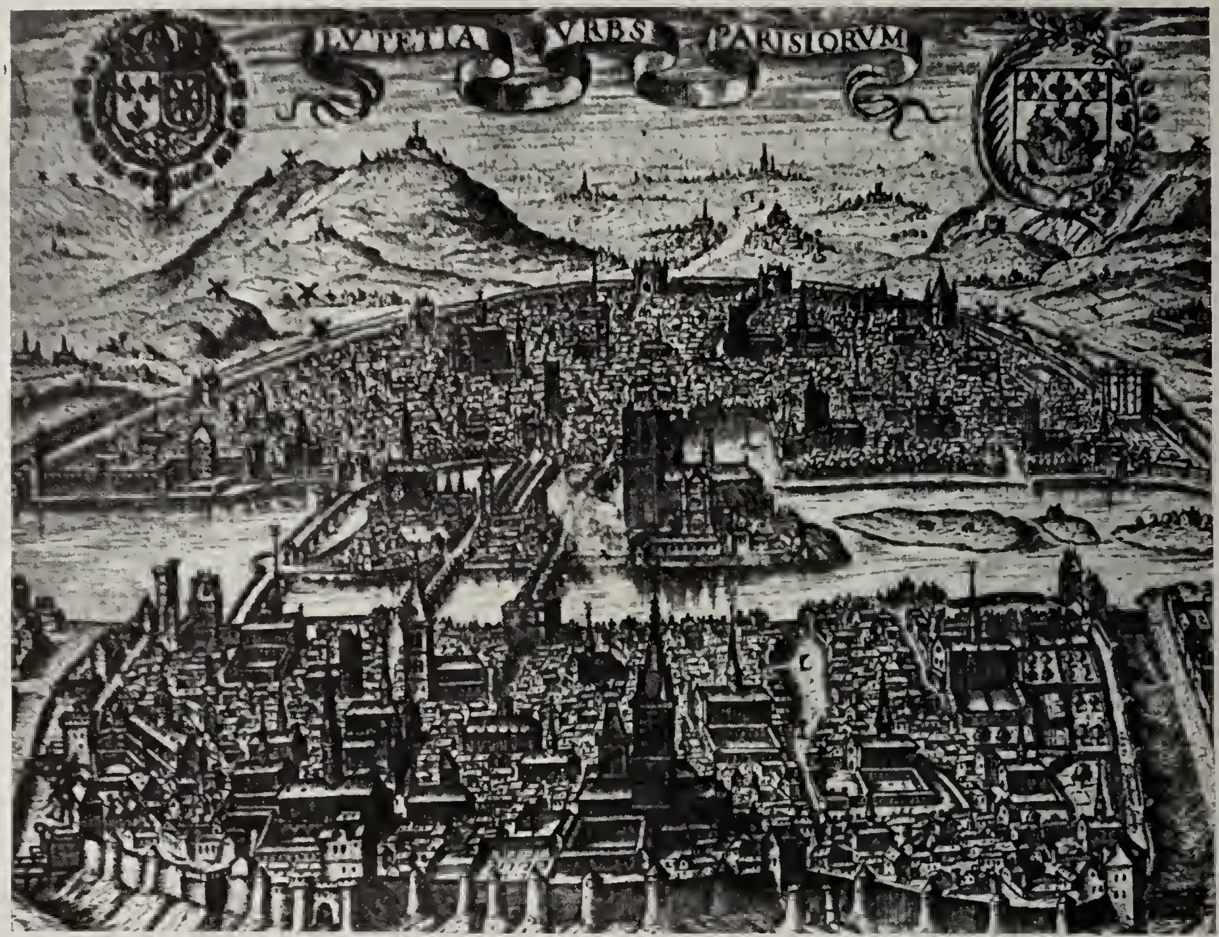


FIG. 8—Panoramic view of Paris at the beginning of the seventeenth century (1607) by Léonard Gaultier. The view is seen from the south (left bank of the Seine). In the center, the Île de la Cité with Notre Dame is still the only inhabited island. In the background the hill of Montmartre to the left and the heights of Ménilmontant and of Belleville to the right, crowned with windmills.

To assure the defense of the city King Philip Augustus decided to enclose it within a wall furnished with towers and fortified gates. It enclosed on the left bank the part of Mont Ste. Geneviève which fronts the Seine and on the right bank the old quarters about the present markets and the Hôtel de Ville. It left outside the Louvre, or, speaking more exactly, the fortress and prison which antedated the palace of that name. This wall was built in the latter part of the twelfth and the beginning of the thirteenth century. For long the section on the left bank remained unchanged. Here in the thirteenth century were built many colleges for the accommodation of the poor scholars eager for learning who were drawn in increasingly great numbers to the Paris schools. It was the period when such illustrious foreigners as the Italians St. Bonaventura and St. Thomas Aquinas, the German Albertus Magnus, the Englishman Alexander of Hales came as teachers to the banks of the Seine. One of these colleges, founded in 1257 by Robert of Sorbon, gave its name to the Sorbonne, which today accommodates a part of the University of Paris. For the future the left bank became the student quarter, effervescent at times but a cradle and home of science.

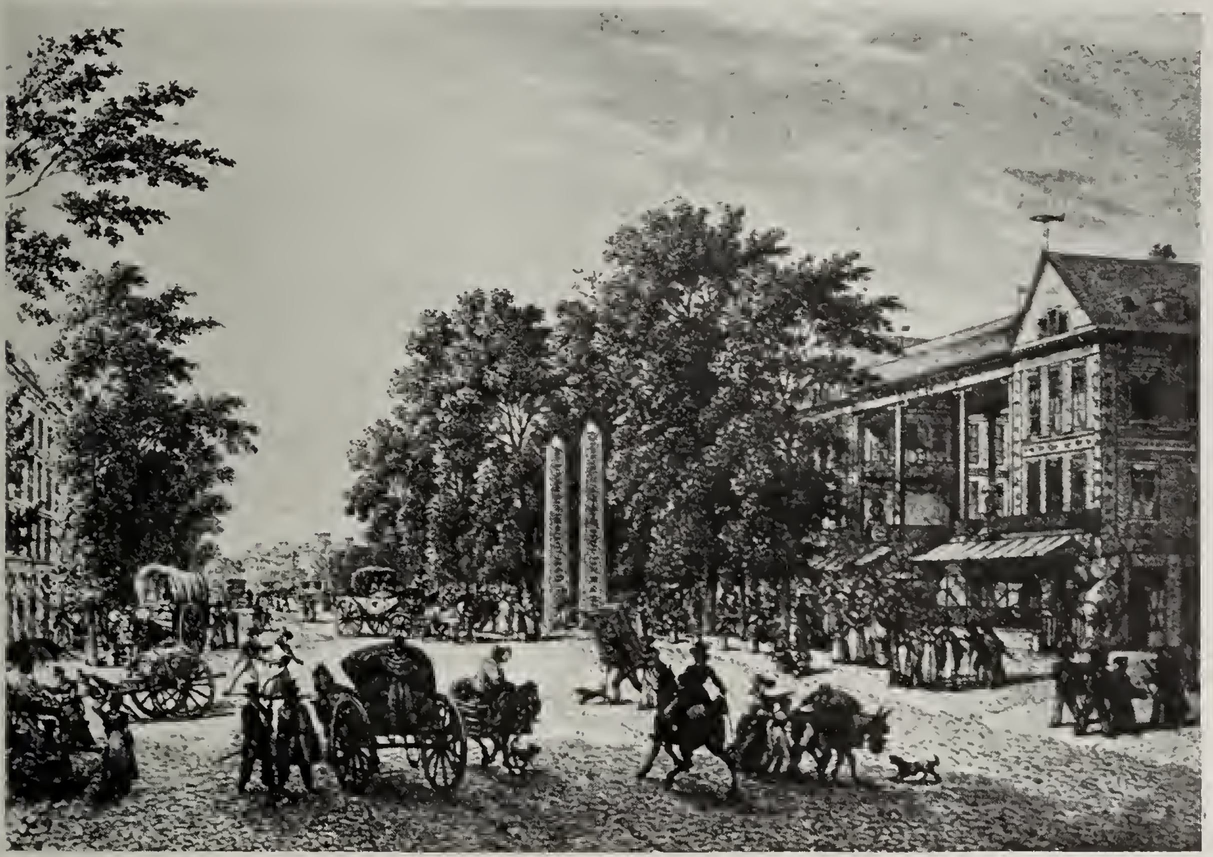


Fig. 9—The Grands Boulevards at the beginning of the nineteenth century. The building to the right is the "Bains Chinois" which gave their name to this part of the boulevard. After a sketch by Bacler d'Abbé, lithographed in "Promenades pittoresque et lithographies dans Paris et ses environs," Paris, 1822.

It was, however, chiefly on the right bank that Paris continued to grow. In the fourteenth century under King Charles V the city was encompassed by a new wall, concentric with the old one, and defended at intervals by bastion towers, the "Bastilles." One of the stoutest of these on the site of the present Place de la Bastille survived until the end of the eighteenth century when its fall at the hands of the people on July 14, 1789, marked the beginning of the French Revolution. The new wall from the northeast side followed the course of the old arm of the Seine deviating to the northwest to approach the river and this time including the chateau of the Louvre built under Charles V in place of the old fortress. Paris was by this time a populous city. A census made in 1329, before the building of the new wall, enumerated 61,098 "hearths," that is to say families or households, corresponding to about 290,000 individuals at least. And yet on vacant areas within the new wall building continued apace.

Paris from the Sixteenth to the Nineteenth Century

The wars and turbulences of the fifteenth century retarded the growth of Paris, and need for a new expansion of the wall did not arise until the sixteenth century. This extension, which dates from the reign of Francis I (1515–1547), affected only the northwestern section on the right bank of the river. Under Louis XIV a new advance on the same side was made in the seventeenth century, and this time the Tuileries palace was enclosed. Within this old wall already lived 500,000 inhabitants, close pressed in the narrow streets lined by tall houses examples of which are still in existence. In spite of the monuments and sumptuous mansions which had been raised in vacant places and without the walls, the Paris of Louis XIV still kept its medieval aspect. But the city continued to grow, and the wall, overrun

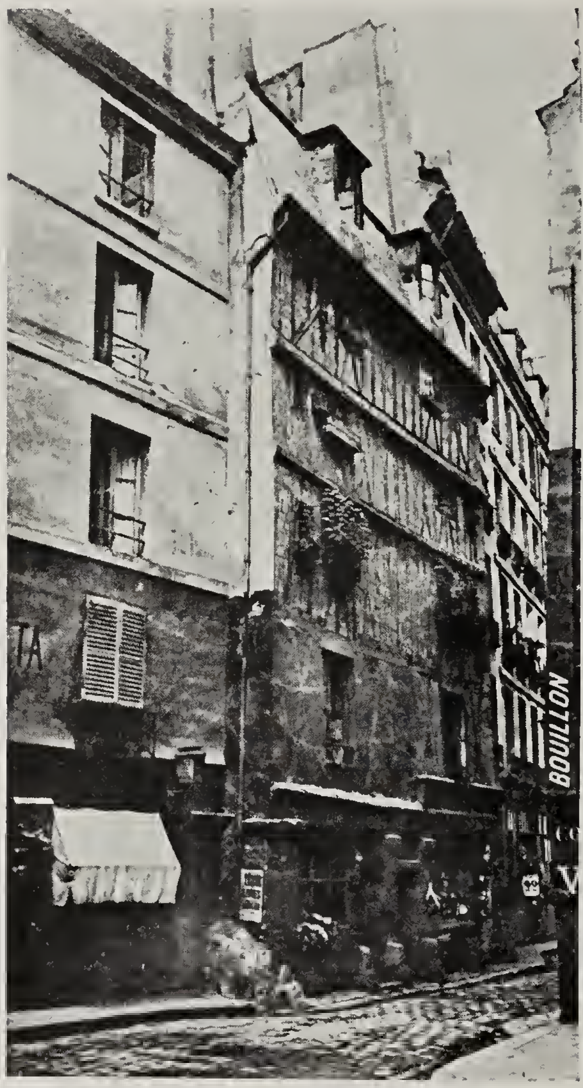


Fig. 10

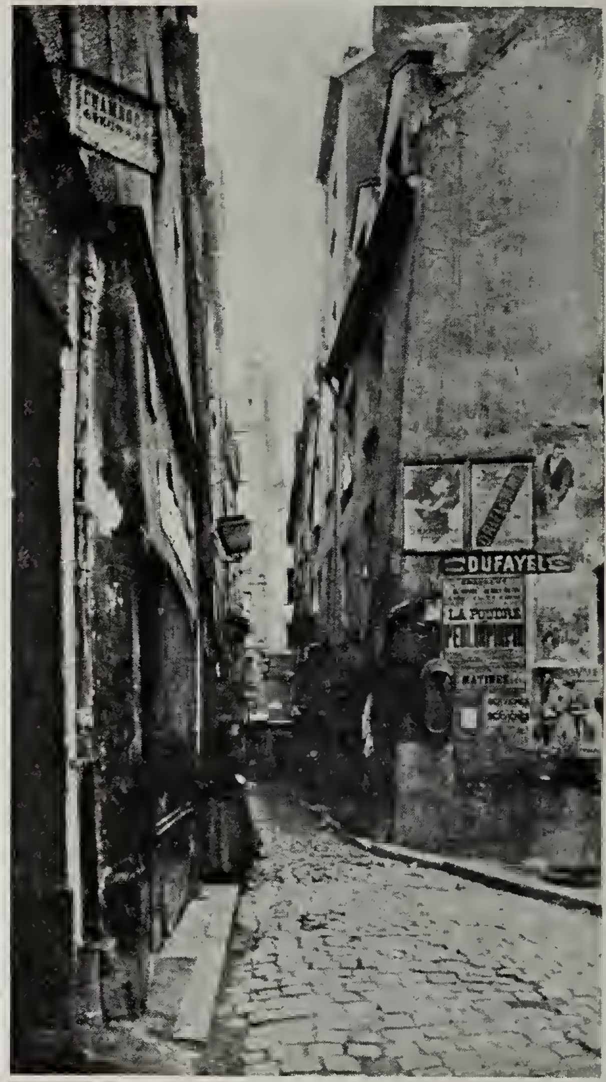


Fig. 11

Fig. 10—Old Paris. The rue Volta (3rd arrondissement). Very old timber-framed house. Collections de la Bibliothèque de la Ville de Paris.

Fig. 11—Old Paris. The rue Brise-Miche (4th arrondissement). Collections de la Bibliothèque de la Ville de Paris.

on all sides, lost its military value. The useless rampart was now transformed into a tree-bordered promenade. This is the origin of the Grands Boulevards—the inner boulevards.

Another extension was made at the end of the eighteenth century, but this time with a fiscal aim. A customs barrier was erected to facilitate payment of the octroi. It took the form of a wall continuous on both banks and well without the old wall. This was the wall of the farmers-general of taxes. Its emplacement is today marked by the outer boulevards. But this wall extended far beyond the city proper and enclosed a broad extent of gardens and cultivations.

We are now on the threshold of the nineteenth century, and henceforth progress becomes more and more rapid. About the wall of the farmers-general, which had seemed much too large in circumference, new suburbs appear and villages grow.

Successive censuses now permit us to measure the regular increase of the population. In 1789, 524,000 people; in 1801, 547,000; in 1817, 713,000; in 1841, 935,000. In 1840 it was decided to surround Paris by a double ring of defenses—a fortified enceinte and a series of detached forts. The enceinte enclosed not less than eleven suburban communes which did not then form part of the city but were incorporated in 1860. In consequence the census of 1861 showed the enormous increase to 1,690,000 inhabitants. The enceinte, its grass-covered ramparts overlooking a deep moat, became a real boundary for the growing town. Without it for a breadth of 200 meters the erection of dwellings, save wooden huts which could speedily be demolished, was prohibited that the defense might not be embarrassed. This belt, known as the "Zone," was invaded by a population mostly of poor folk whose small gardens gave to it an illusive look of the country.

Modern Paris

The date 1860 corresponds approximately to the beginning of a new period, the contemporary period. Since then the population has not ceased growing. In 1872 it was 1,851,000; in 1881, 2,269,000; in 1891, 2,447,000; in 1901, 2,714,000; in 1911, 2,888,000; in 1921, 2,906,472. The smallness of the last increase, 18,000, is due not only to the enormous losses caused by the war but also to the exodus of the population to the suburbs.

This exodus is itself the result of the continued development of means of transportation. The great transformation dates from the middle of the last century with the completion of the great railway lines. In 1856 all the lines setting out from Paris reached their termini. At this time the numerous small companies which had been formed at the beginning fused into six distinct systems. Five of these have their point of departure in Paris; the western system (Paris to Brest and Havre), northern (Paris to the Belgian frontier), eastern (Paris to Strasbourg and Basle), Paris to Lyons and the Mediterranean, Paris to Orléans (prolonged to Bordeaux).

Naturally it is in the quarters on the outskirts where more free space was available that the railroad stations have been built. While the process of obtaining adequate ground for the great terminal stations was under way it was decided at the same time to put into operation long projected plans for opening up the old quarters of the city. To this rebuilding and beautifying of Paris, work which lasted through the reign of Napoleon III (1852–1870), the name of the prefect Haussmann is attached. The narrow streets and alleys blocking the views of such monuments as the Louvre, the Pantheon, and Notre Dame were removed. Fine perspectives were opened up everywhere. Broad tree-lined avenues were run in straight lines from old Paris across the newly incorporated quarters. But still today close at hand much of the old aspect survives. Near the tall houses of six or seven stories that line the new roads are narrow, crooked streets; and on the hills of Ménilmontant and Belleville one can still see little rustic cottages in the midst of gardens. In the new quarters fine parks have been laid out, as at Buttes-Chaumont where the old plaster quarries have been turned into pseudo-natural grottoes. Transformation has been continuous since 1870. Completion was only retarded by the war, and already plans are under way for the beautifying of greater Paris.

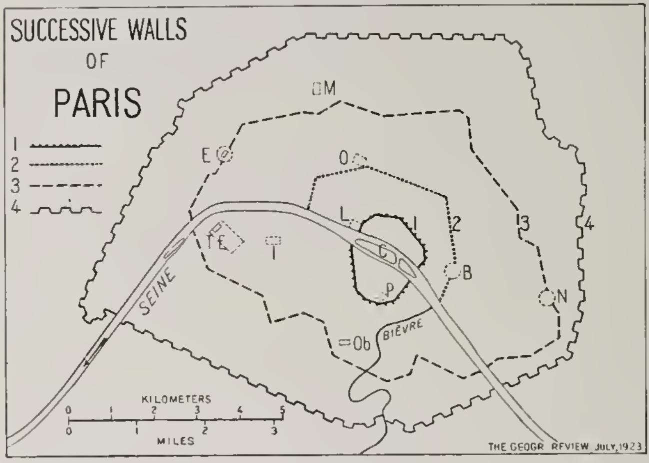


FIG. 12—Successive walls of Paris. 1, wall of Philip Augustus, thirteenth century; 2, wall at time of Louis XIV, seventeenth century; 3, wall of 1789; 4, wall of 1840; B, Place de la Bastille; C, Cité; E, Place de l'Étoile; I, Invalides; L, Louvre; M, Montmartre; N, Place de la Nation; O, Opéra; Ob, Observatory; P, Panthéon; TE, Eiffel Tower.

The building of railroads had other consequences for Paris than those described above. It permitted the easy carriage of coal from the mines of the Nord. Before this Paris engaged little in industry, mostly in home industries whose success depended upon the skill and taste of the workman. Now factories proper have been installed, most of them in the suburbs. The railroads, however, are not the only contributors to the coal supply. In an earlier number of the *Geographical Review*[3] was shown the debt Paris owed to river navigation and the magnitude this has assumed today. Thanks to such facilities Paris has also become a great commercial center, the great permanent market of France. Before the war, excluding building materials and coal, Paris exported as much merchandise as she imported. This multiplication of industries and growing commercial activity has been the determining cause of the afflux of people into the city from other parts of France and from abroad.

But the population of Paris no longer crowds itself as before into the

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[3] Albert Demangeon: The Port of Paris, *Geogr. Rev.*, Vol. 10, 1920, pp. 277–296.

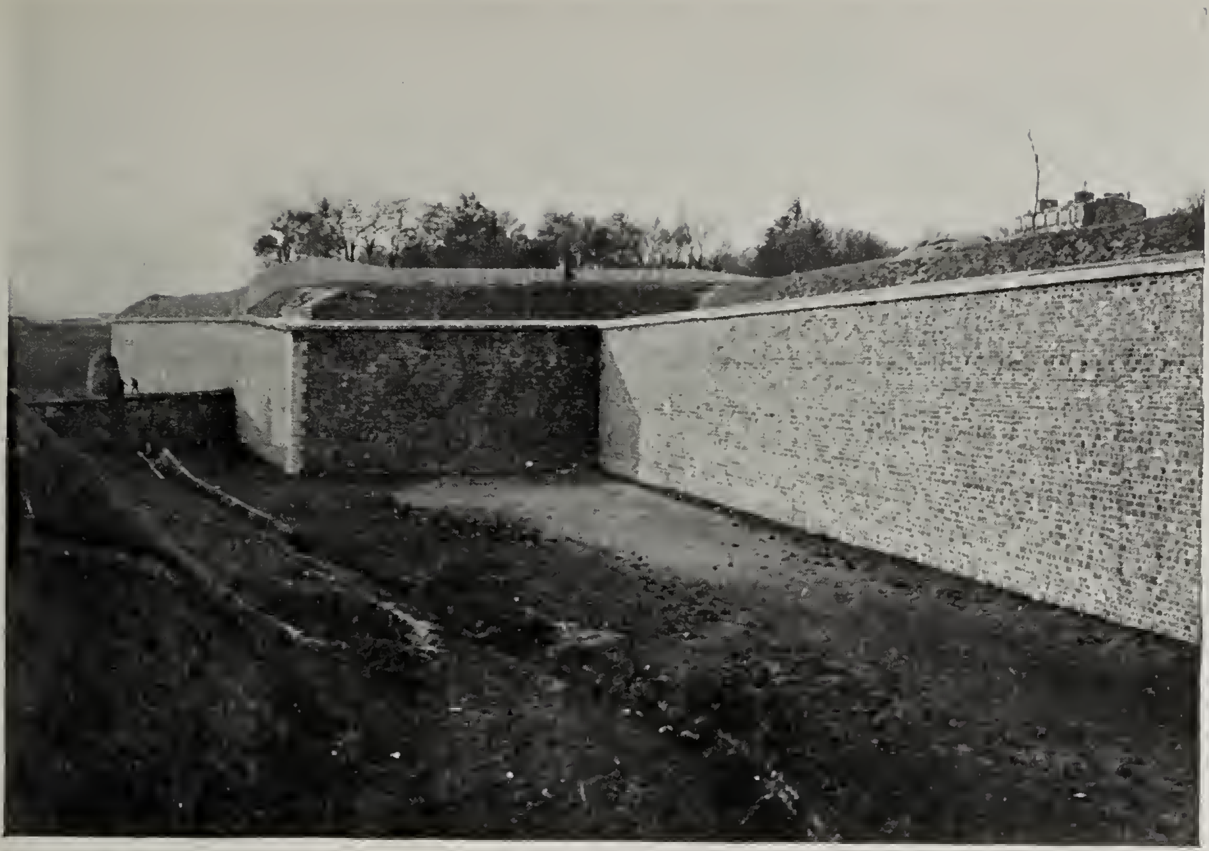

FIG. 13

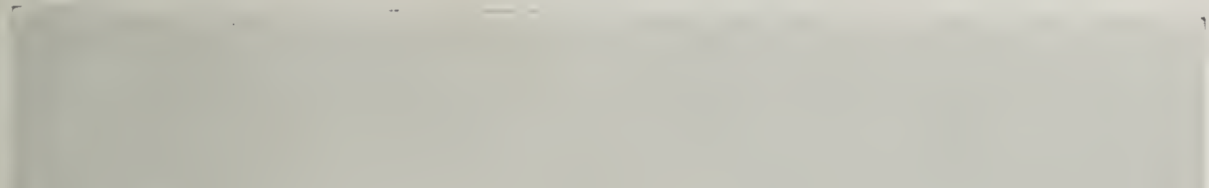

FIG. 14

FIG. 13—The wall of the fortifications of Paris now in process of demolition.

FIG. 14—View in the "Zone," the 200-meter broad space in front of the fortifications where the erection of permanent buildings was prohibited for military reasons. The Zone will disappear as the fortifications are destroyed.

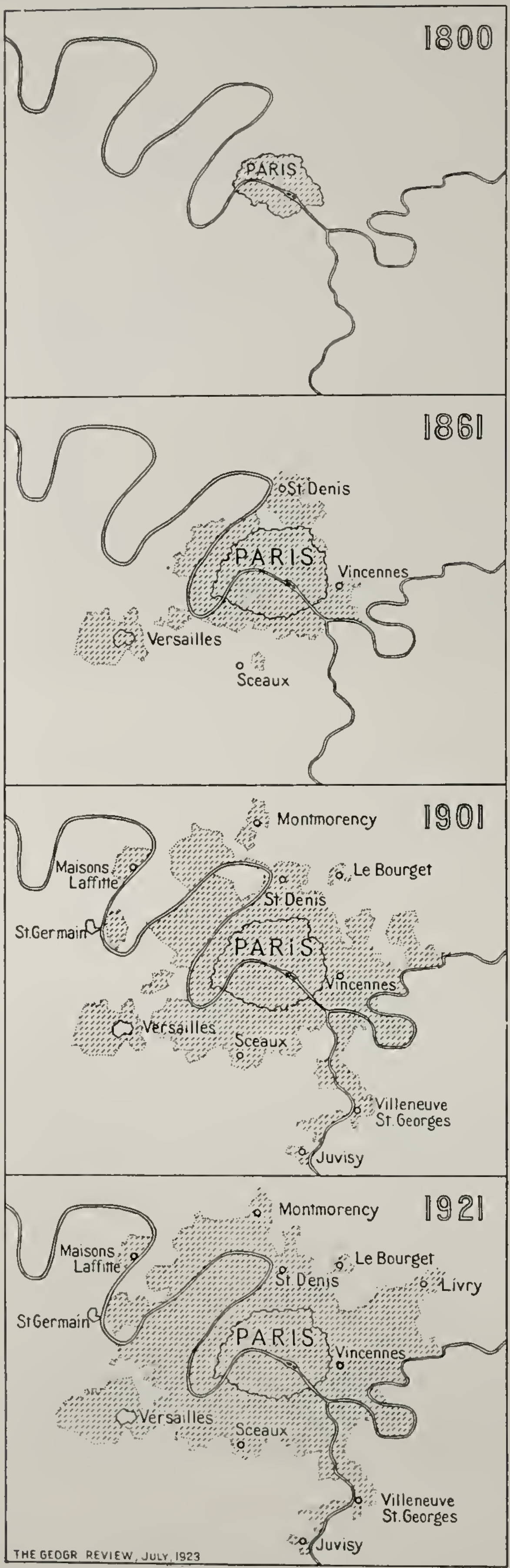

Fig. 15—The growth of Paris and its environs. The shaded areas have at least 10 inhabitants to the hectare. (The first three figures after L. Bonnier in *La Vie Urbaine*, Vol. 1, 1919, pp. 7–76.)

center of the city. The broad spaces which have been cleared to make way for new streets, the increasingly great space occupied by stores and offices have pushed the population towards the outskirts where there is more room. The center of Paris, like the center of London, is becoming a city of work but not of residence. The exodus towards the outskirts has necessitated the creation of a multifold system of transportation—omnibuses, horse-drawn at first, now automotive, tramways, and subways—which in turn has still further accelerated the daily displacement of the population. The subway system, the Métropolitain, has not yet been carried beyond the fortifications because of the opposition of small tradesfolk anxious not to lose their clientele. But public interest sooner or later will carry the system beyond its present limits into the suburbs. The necessary connections are now maintained by numerous tram lines and to a greater degree by the suburban railway system. It is sufficient to witness the arrival of the morning trains to appreciate the enormous stream of people that the suburbs each day turn into the city.

Even before the war the fortifications of Paris had been regarded as an anachronism. Since 1870 the defensive line had been carried well beyond the old forts so that the new "entrenched camp" was not less than 133 kilometers in circumference. The war showed still more clearly the uselessness of a continuous fortified enceinte. Demolition commenced in 1919. Parts of the old ramparts only will be kept as memorials: in place of the rest will be laid out parks and workingmen's quarters. The "Zone" will disappear, to the great regret of lovers of the picturesque. Soon nothing will separate the quarters incorporated in 1860 from "extra-mural" Paris. It is this whole that we must today consider as urban Paris.

Greater Paris

This agglomeration considerably surpasses the boundaries of the administrative district of the *département* of the Seine. It invades the contiguous *départements* of Seine-et-Oise and Seine-et-Marne. It is not, however, concentric with the old fortifications but forms antennae-like elongations along the railroads. For this greater Paris is being occupied more and more by Parisians having their occupations in the town itself, heads of industrial concerns and commercial houses, and especially clerks and other small business folk, glad when the day's work is finished to breathe a freer air and work in their little gardens, for the Frenchman has an hereditary love of the soil. Side by side with this element is the indigenous working population, market gardeners who nightly carry to the central markets the vegetables and flowers they raise from a soil that is never idle. Certainly this dispersion of the Parisian population into the neighboring country is not to be regretted: indeed one may wish to see it extended to include all the unfortunate beings still shut up today in close-crowded quarters.

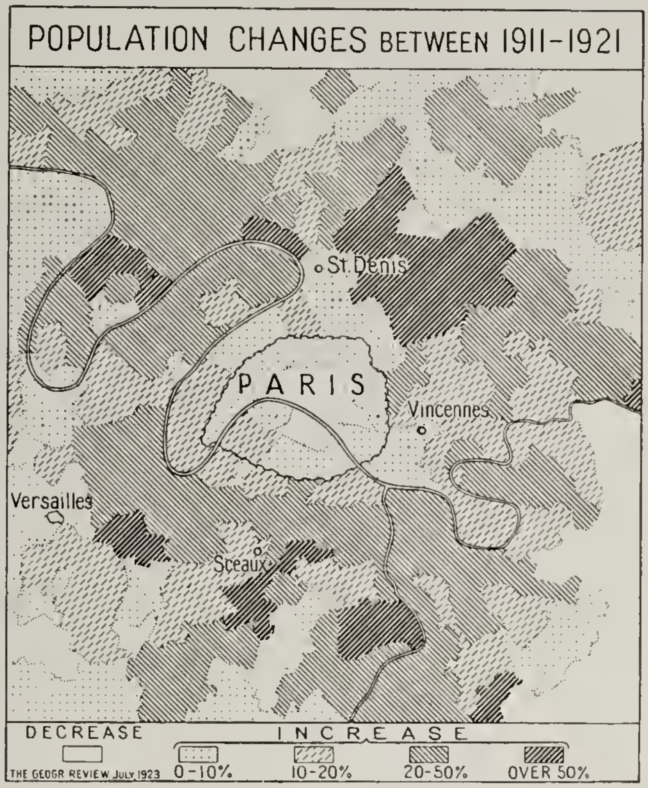

Fig. 16—Changes in the population density of Paris and its immediate vicinity (compare the map Fig. 17) in the decade 1911 to 1921. Scale approximately 1:650,000.

The last census permitted us to evaluate more precisely the number of people now living in the suburbs of Paris. The *département* of the Seine (population of Paris excluded) had 1,266,000 inhabitants in 1911. In 1921 it had, in spite of the enormous losses sustained by the war, 1,505,000. With Paris it counts 4,411,916 souls. But this greater Paris, as we have said, also includes parts of neighboring *départements*, and there also increase has been considerable. The gain in the *département* of Seine-et-Oise between 1911 and 1921 exceeds 104,000 and is exclusively due to communes forming part of the Parisian agglomeration. In giving the population of greater Paris as 4,500,000 one certainly does not err on the side of excess.

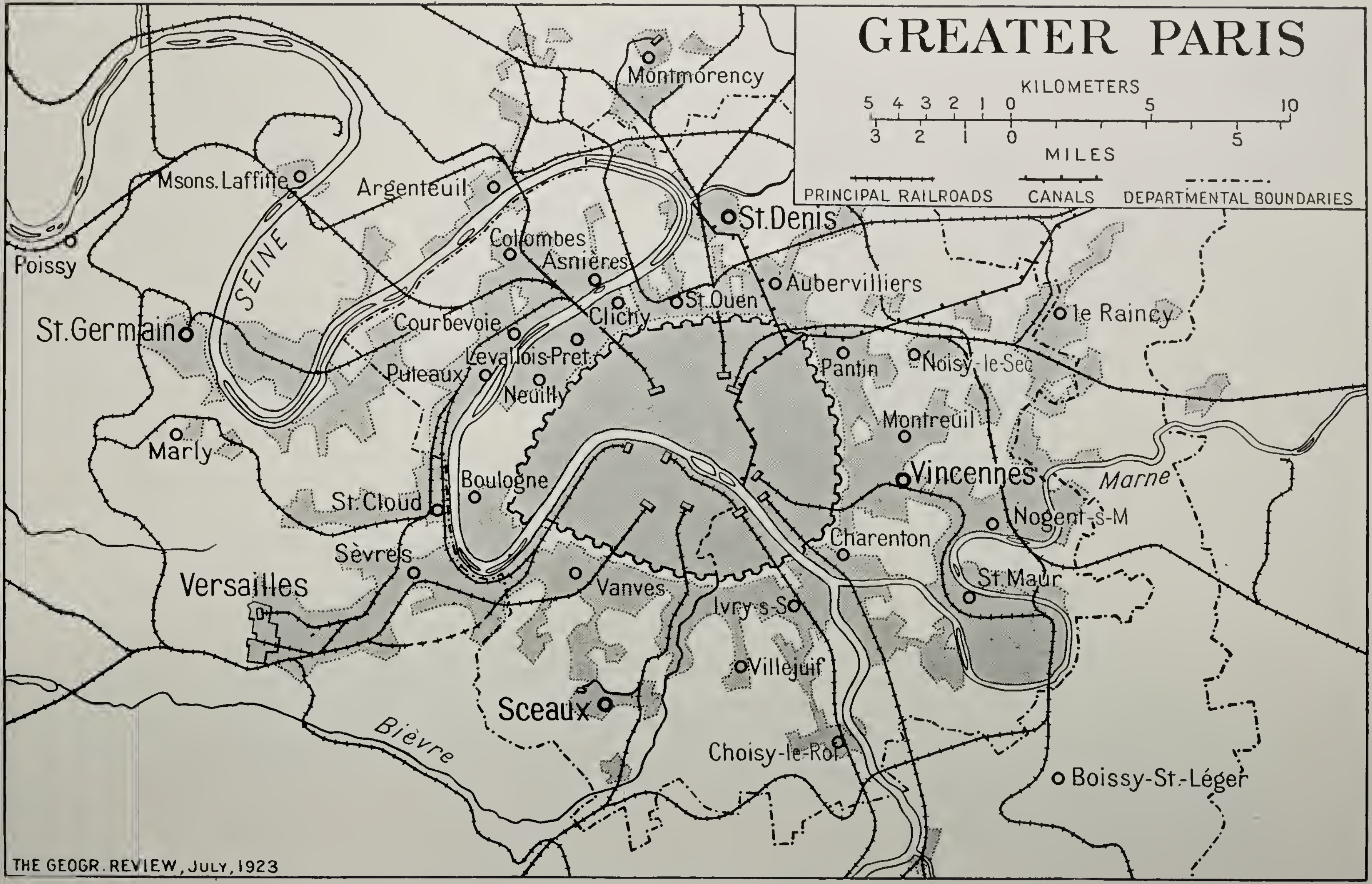

Fig. 17—Map of Greater Paris. Scale approximately 1:266,000.

Suburban Paris is a prolongation of the quarters of the city itself. As Paris for the last century has grown chiefly in a westerly direction, so it is to the west that we find the most densely peopled suburbs. On this side the communes of Neuilly (51,590), Levallois-Perret (73,639), Clichy (50,165), and, outside the *département* of the Seine, Puteaux (33,503), Courbevoie (46,053), Asnières (49,607), Bois-Colombes (19,888), Colombes (32,271) form, with Boulogne-sur-Seine (68,008), a group of more than 400,000 souls. But while Neuilly, bordering the beautiful grounds of the Bois de Boulogne, is the continuation of the fine residential section about the Arc de Triomphe, Levallois-Perret and Clichy make transition with the industrial suburb of the north which is a prolongation beyond the fortifications of the industrial quarter of La Chapelle. In this area, which has surrounded with factories the old church of St. Denis, lives a working-class population of over 175,000 souls. It is here that coal from the fields of the Nord is most easily brought by rail or water. This industrial zone includes Aubervilliers (40,832), St. Ouen (50,848), St. Denis (76,358), and the bordering communes. It is growing eastward by Pantin (38,975) towards Noisy-le-Sec (16,306); but it has respected the heights, once entirely wooded, which here overlook the valley of the Marne.

At the foot of the hills of Montfermeil is a considerable colony of small business people whom the railway puts in ready communication with the quarters in which are their shops and offices (altogether over 70,000 people). Prolongation towards the east of the elevated ground of Ménilmontant and Belleville has acted as an obstacle towards the outward pressure of population. This section is still only occupied on the immediate outskirts of the great city, but farther to the south nuclei of dense population reappear round the old chateau of Vincennes and beyond its woods laid out in walks and drives which overlook the confluence of the Seine and Marne. Here there are about 300,000 people.

The quarters of Paris on the left bank of the river have not furnished their suburbs with such large contingents. An almost continuous zone of industrial communes crowds over 200,000 souls about the old fortifications; but beyond there are empty spaces. The plateau lying between the Seine and the Bièvre is still largely given over to cultivation. In these two valleys served by railways the Parisian population has advanced, round the old villages of Sceaux and Bourg-la-Reine. But the movement is spreading and has reached the upper valleys of the Bièvre and the Yvette where the elegance of the summer homes is in harmony with the beauty of the site. Similarly country houses and *châteaux* continue along the pleasant hill slopes overlooking the left bank of the Seine from Meudon to St. Cloud and up to St. Germain. By the ravine of Sèvres, without leaving a gap in the populated zone, one reaches Versailles, whose tranquil charm has drawn thither many a Parisian. Connected with Paris by three railway lines, Versailles with its 65,000 population is today included within suburban Paris.

In many parts the suburbs have preserved their look of the country. If great establishments have been constructed on the parts which lie nearest the city, elsewhere small one-family houses separated from their neighbors by their little gardens are characteristic. Only the houses of the old villages are grouped together and with their narrow irregular streets break up the monotony of the broad roads and new buildings. Between past and present a junction has not yet been achieved. The change has been too rapid, and the old population of small farmers and market gardeners continues to live as before without mingling with the new comers.

Paris itself keeps in some of its quarters a scarcely changed air of the past. As in the old Paris of the Middle Ages, where the guilds of craftsmen were grouped by streets, the present-day population is not distributed by hazard but according to occupations and habitude. The vicinity of the Place de la Bastille has always been the domain of cabinetmakers. In the old *hôtels* of the Marais, which were in the eighteenth century a center of fashionable life, are installed today the shops of workers in bronze and copper. The valley of the Bièvre is the quarter of the leather dressers and tanners, but the polluted stream has now been converted into a sewer. In the center of the city in the neighborhood of the Bourse are the banks and large commercial houses which directly or through agencies handle the affairs of the entire nation, for today there is no great French industrial concern which does not have representatives and offices in the city. It is also the quarter of that Parisian art *par excellence*, the creating of fashions, which supports thousands of women. The left bank of the river has its great publishing houses. This is the domain of the savants and artists and also, but further to the west, of the diplomatic corps. They are housed between the Senate and the Chamber of Deputies in the old mansions still surrounded with shady gardens which were in the eighteenth century the Paris of aristocracy and wealth before it migrated to the new quarters about the Arc de Triomphe and the Champs-Elysées. Such is workaday Paris, scarcely known to the tourist and very different from the noisy Paris of the boulevards, the theaters, and pleasure places.

Conclusion

Four and a half million people is one-tenth of the population of France. This disproportion between Paris and the other great towns of France has been a subject of anxious concern, and measures have been proposed to counteract what has been considered an excessive centralization. In reality the growth of Paris is largely due to general causes. Everywhere modern life with the rapid growth of communication which diminishes distance favors the movement towards large towns. These in France, as elsewhere, have been aggrandized at the expense of smaller towns; and they have become more and more the centers of the great French regions. Paris in particular has benefited by the advantages of its position. It is probable that these general causes have not yet ceased to operate. It may be that current economic difficulties will slacken the movement, it may be that new industries will find more advantages at a greater distance from the immediate suburbs; but according to all appearances Paris will continue to grow, especially on the outskirts and especially when the barrier of the fortifications has disappeared.

But other causes have assured Paris her preëminence. Chief of all, as we have seen, is her function of capital. And this preëminence has incontestable advantages. Paris, the center of French life and the focus, one may say, of French thought, has largely contributed to the diffusion of that body of sentiment and ideas which is the soul of a nation. It is the idiom of the bourgeoisie of Paris which has superposed itself over other dialects and has become the common language of France, that which has been diffused and fixed by the great writers. It is the French administration whose head is in Paris which has similarly penetrated all the French provinces. This centralization, initiated and pursued by the Capetian kings, perfected by the Revolution and the Empire, should not be too harshly criticized today: it has made the unity of France, the safeguard of the country in her hours of peril.

THE FRANCO-SWISS FREE ZONES

By Charles Biermann

Universities of Lausanne and Neuchâtel

Switzerland is well marked off by nature from her encircling neighbors. Were her political boundaries nonexistent she would still be a country apart. The Jura, which encompasses the northwest, and the Alps, which occupy the south, are high enough for the winter snows to render communications difficult. The slopes are steep enough to compel the roads to seek the few natural passageways; the climate is so inclement that extensive areas are completely closed to habitation or are open to temporary utilization only. The empty spaces of high mountains between Switzerland and her neighbors are the best frontiers because they prohibit contact, whereas political frontiers so often provoke it.

Far apart in the northeast, where the Rhine furnishes only a poor frontier, the Jura and Alps draw together the southwest. The Jura, indeed, can be considered in effect as a branch of the Alps, uniting with it in the Échaillon, on the left bank of the Isère below Grenoble. Between the Jura and the Fore-Alps is a difference of structure only: the former is less intensely folded, the folds being the well-known type of simple undulations.

The Neutral Zone of Savoy

The angle of contact between the Jura and the Alps is the region of Savoy. Savoy is geographically Swiss if not so politically. In 1860 it was detached from the kingdom of Sardinia and united to France. Savoy, however, has also enjoyed a certain affiliation with Switzerland. The Congress of Vienna (1815) extended the guarantee of political neutrality not only over Switzerland but also over a large part of Savoy, including the old provinces of Chablais, Faucigny, and Genevois. Switzerland was authorized to occupy this neutral zone in time of war. Up to the present she has not found it necessary to avail herself of this right, and it is improbable that such an exigency will arise in the future.

The Lake of Geneva as a Boundary

A large body of water, the Lake of Geneva, lies between Savoy and Switzerland. Far from being a natural dividing line it is a bond of union between the peoples of the two shores. The lake has served as a political boundary only since the sixteenth century, and up to the present it has not functioned as an economic boundary. Relations between Savoy and Switzerland are close. Steamboats and sailboats traffic between French and Swiss ports. The Swiss shore, the richer and more populous, offers a market for the vegetables, fruits, and other agricultural and horticultural products of Savoy and the more productive fisheries of that side of the lake. Large lateen-sailed boats carry building stone from Meillerie in Savoy for the towns of Vaud, and from this same source comes the material for the supporting walls of the terraced vineyards of Lavaux. Savoy also sends the necessary seasonal labor for the vineyards, while in the Swiss towns bordering the lake are important colonies of Savoyards, generally of the laboring class—day laborers, domestic servants, small tradespeople. Between these emigrants and the country of their origin there is constant intercourse.

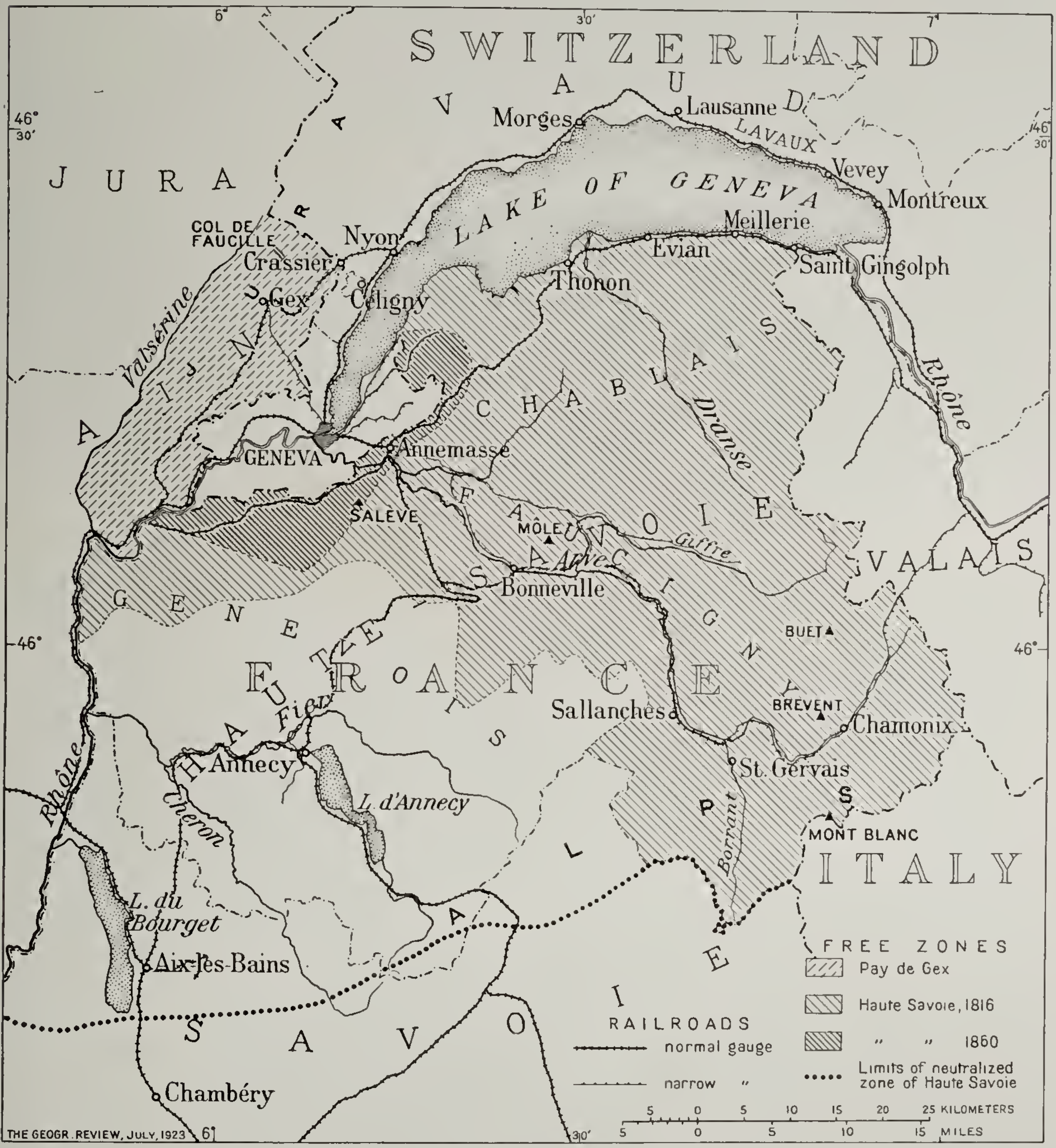

FIG. 1—Map showing the customs Free Zones of Gex and Upper Savoy and the neutralized zone of Upper Savoy.

The village of St. Gingolph on the southern shore of the lake is divided by the torrent of the Morge. On one side is Savoy, on the other the canton of Valais. Although the two halves of the village belong to two different states, they have long since formed a single commune and still constitute a single parish (Roman Catholic) whose church is situated on the Savoyard side. The property of the bourgeoisie is still undivided, lying indifferently in either territory. Assemblies and festivals and other manifestations of public life are held in common. Traffic passes to and fro uninterruptedly by the bridges over the stream, and the inhabitants of the Swiss side cross it on their last journey—to the common cemetery.

On the other shore of the lake somewhat similar conditions are seen in the village of Crassier at the foot of the Jura. A stream traverses it separating the village of the canton of Vaud from that of the Pays de Gex, which has kept the old form of the name, Crassy. Difference of religion—Protestant on the one side, Roman Catholic on the other—accounts for the fact that Crassy does not enjoy communal autonomy (it is dependent on the commune of Vésenex), for which reason the relations between the inhabitants of the two parts of the village are less close than in the case of St. Gingolph.

The Situation of the City of Geneva

Until a century ago Geneva was in much the same situation. This old city, the natural capital of Genevois, became separated from the rest of the province in the struggle for independence against its bishop and against the counts and dukes of Savoy. At the end of the eighteenth century it possessed only an insignificant territory comprising the town and thirteen scattered rural communes, enclaves in Savoyard territory. At the gates of the town on the other side of the Arve lay Savoy. Savoy likewise extended along the right bank of the Rhone from Petit-Saconnex on the outskirts of Geneva, at least until 1601 when the Pays de Gex was ceded by the duke to the king of France. When Savoy became united to France for the first time, in 1792, Geneva was only a little enclave in French territory and six years later lost its independence. Restored in 1814 to its ancient freedom the territory of the city was shortly increased by the addition of six French and sixteen Savoyard communes with the object of assuring continuity of the Genevan territory with the rest of Switzerland. Even with this enlargement the canton of Geneva, with its area of 277 square kilometers, remains the smallest Swiss canton next to Zug. Furthermore, it only touches Swiss territory on about five kilometers, the enclave of Céligny in the canton of Vaud not included, while the French frontier (Pays de Gex and Savoy) extends over fifty kilometers. The canton of Geneva is too small to be sufficient in itself, and its sustenance zone is in France rather than Switzerland.

In fact, throughout the nineteenth century as in preceding centuries Geneva has drawn its food supply from the neighboring regions of France. It has been supplied by the market gardeners and farmers of Savoy and of the Pays de Gex, who bring thither their produce by cart, while other foodstuffs from greater distances come in by rail. The line from Eaux-Vives to

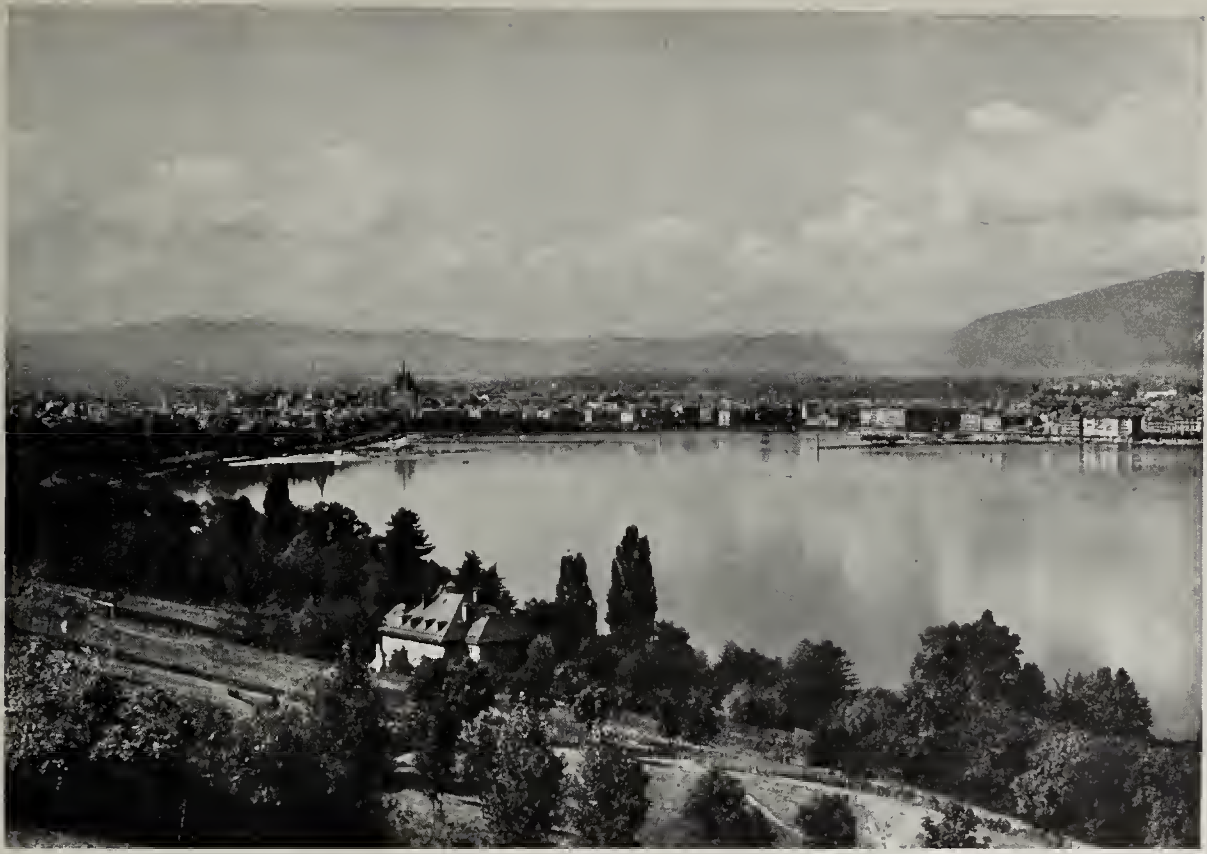

FIG. 2

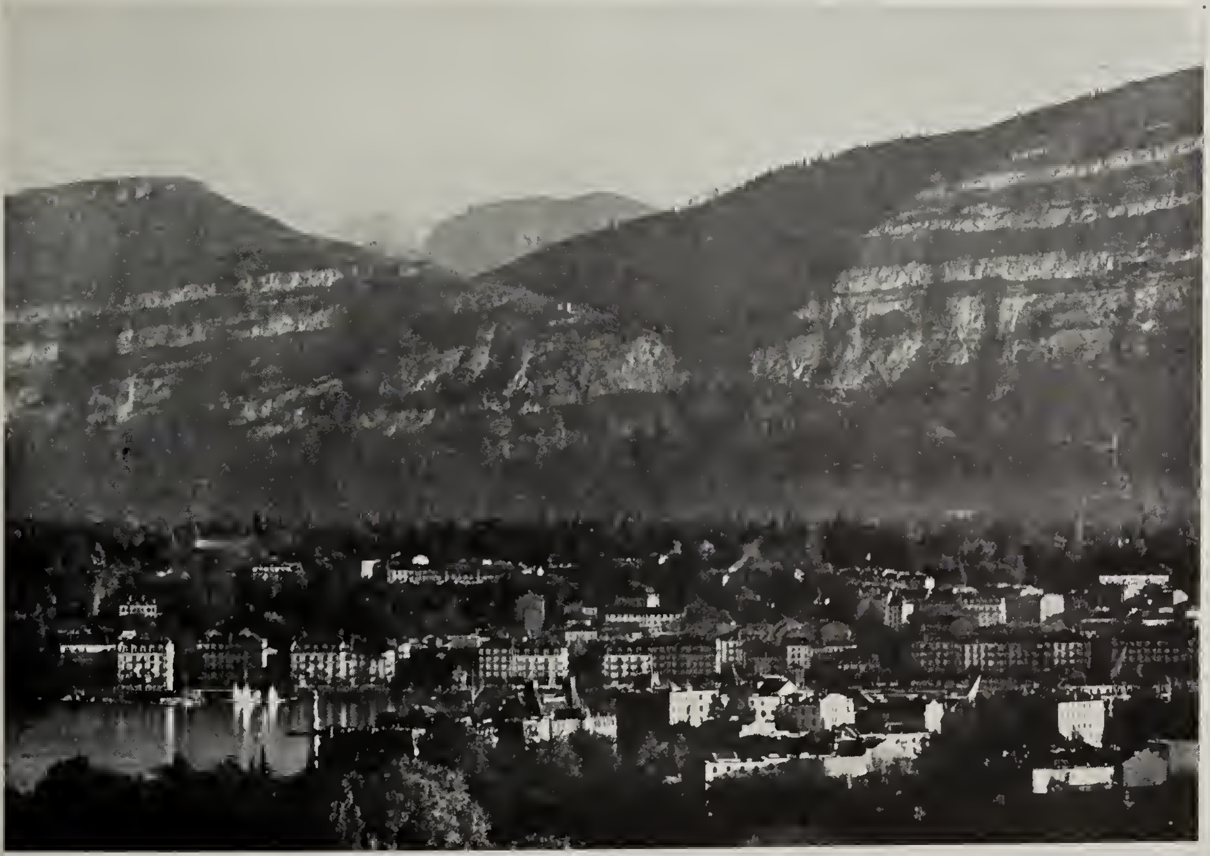

FIG. 3

FIG. 2—Geneva seen from the lake: the roadstead; to the left, the cathedral of St. Pierre; in the middle ground, territory of the canton of Geneva; in the background, the mountain girdle (to the right the Crédo fronting the Montagne de Vuache) pierced by the gorge of the Rhone.

FIG. 3—Geneva and Le Salève, telephotographic view. Petit Salève to the left, Grand Salève to the right. In the cut between the two runs the rack and pinion railway from Veyrier to Monnetier. The calcareous walls of Salève furnish a training ground for alpinists.

Annemasse, by which Geneva is connected with the lines of Bellegarde, Thonon, Annecy, and Chamonix, and an important narrow-gauge system more than 100 kilometers in length unite the town not only with the farthest points of the Genevan country but with places beyond its limits. Conversely the French regions have sought products of Genevan industry. Geneva is the commercial metropolis of all the surrounding country without regard to nationality. No other town comes anywhere near it in size. It is the center of attraction for the rural population. In 1910 it had a colony of some 28,000 French, nearly all from Savoy and the Pays de Gex.

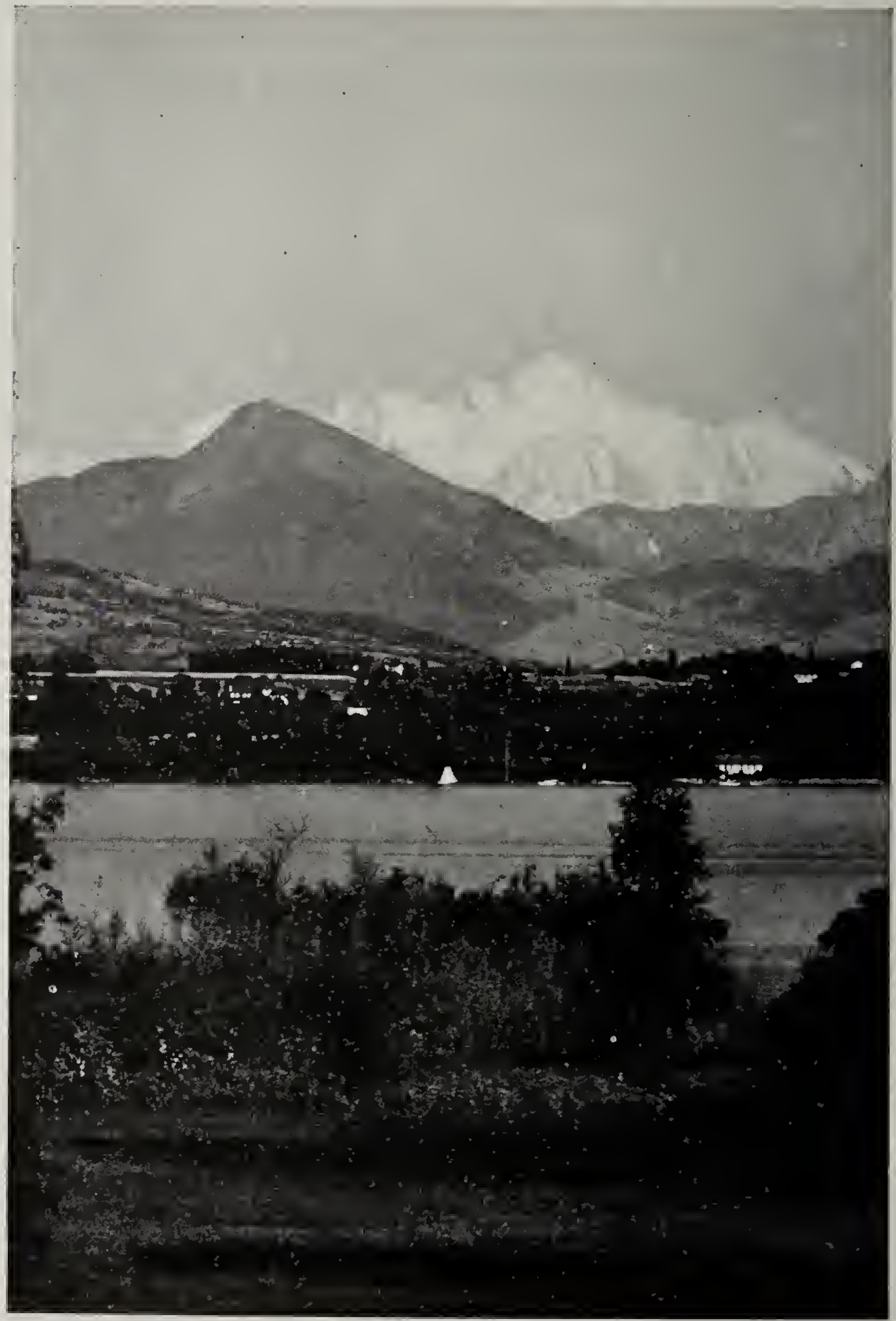

Fig. 4—Mont Blanc seen from Ariana (Geneva), telephotographic view. The lake, the mollassic hills, and the flysch Prealps (Voirons) covered with cultivation, forests, and pastures are dominated by the rocks and snows of the great mountain.

On the other hand, as the city grows, Genevan influence spreads. The Genevans have acquired considerable interests in Savoy: in lands, farms, factories, hotels, railroads. They have bought country estates and hunting preserves; they frequent the Savoyard inns and hostelries famous for their good cheer, and thither they take their week-end excursions to field and mountain.

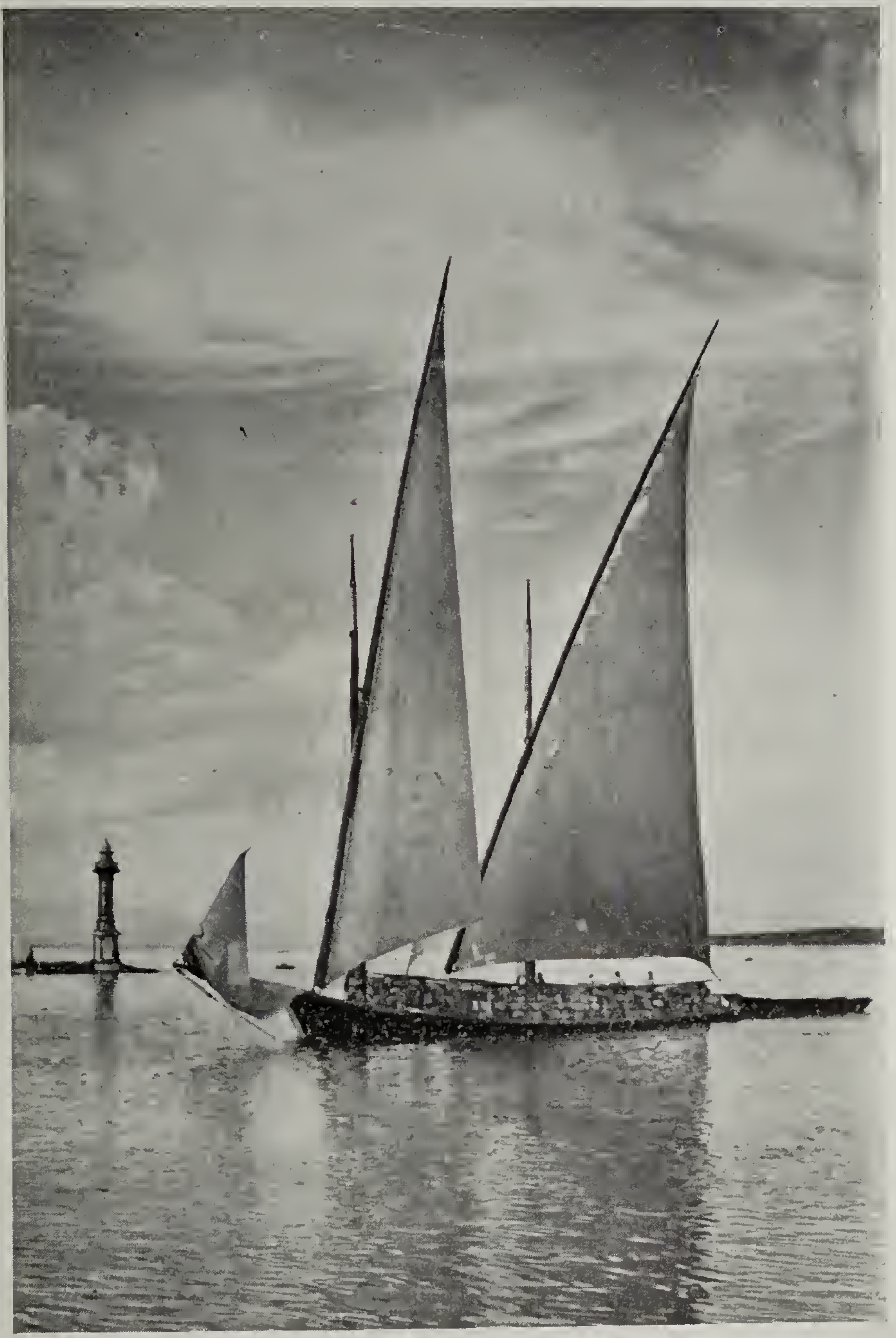

FIG. 5—Lateen-sailed boat loaded with stone from Meillerie entering the port of Geneva.

The canton of Geneva lies entirely on the plateau; a vast amphitheater surrounded by mountains territorially French. The Salève stands right on the frontier and, though it is not very high (about 1380 meters), offers from its summit a remarkable panorama of the town and its surroundings. It has

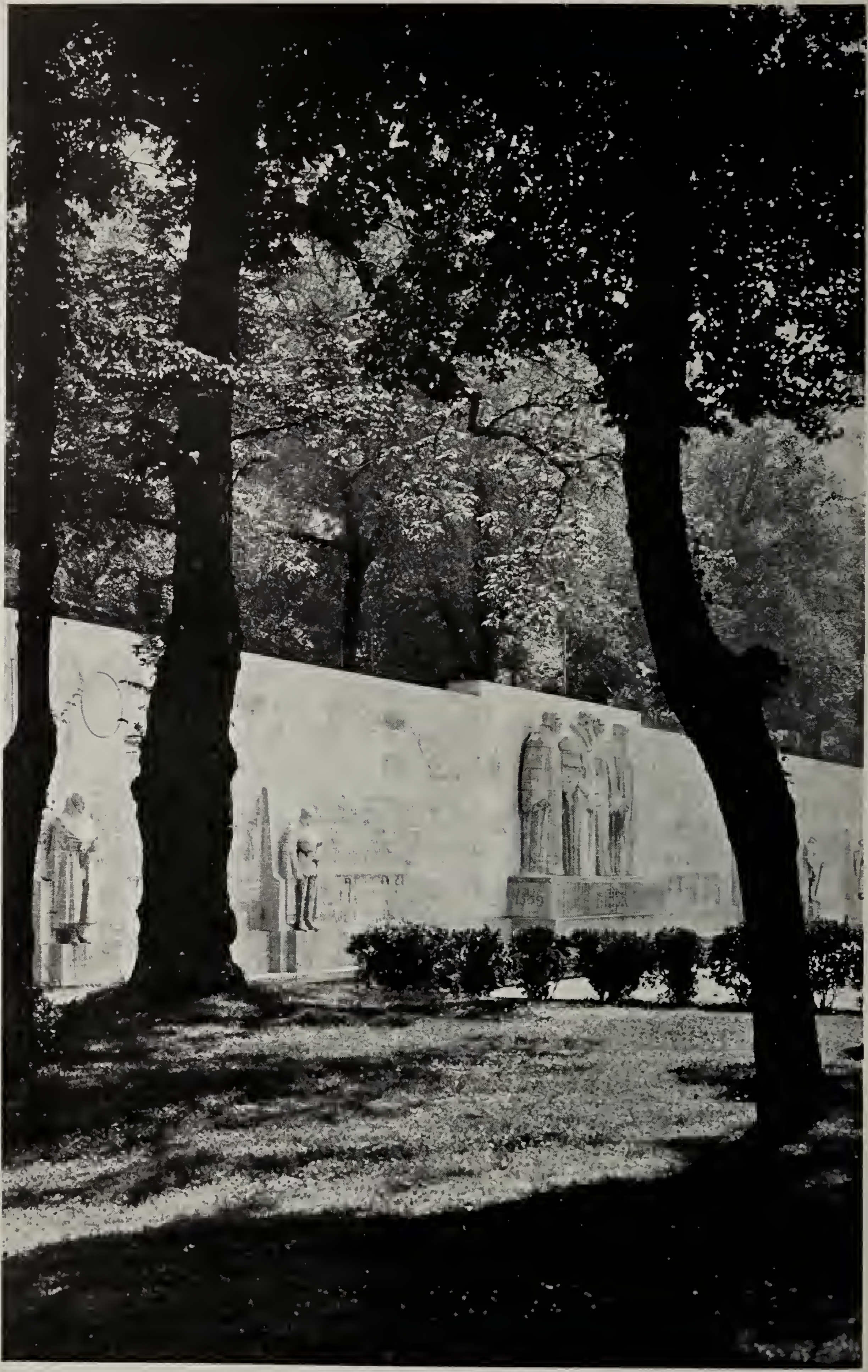

FIG. 6—The "Wall of the Reformers," a monument recently erected on a site in front of the old wall of Geneva. Isolated, from the religious point of view, by wholly Catholic regions (Savoy and Gex), Geneva has owed its dominance to its great reformers, Calvin, Farel, Beza, Knox.

been the training ground of most of the Genevan alpinists. On its northwestern side precipitous rock faces offer practice enough for mastering the granite needles of Mont Blanc. Mont Blanc too may be fairly claimed as a Genevan mountain. Was it not a Genevan, De Saussure, who made the first scientific studies and one of the first ascents of the mountain?[1]

Here alpinism had its rise, and here have been seen the beginnings of its transformation. It was a Genevan, Durafour, who made the first landing from an airplane on the Dôme du Goûter.

The Arve, which has its source in the glaciers of Mount Blanc, opens a magnificent route from Geneva into the Alps. But unfortunately it is a cul-de-sac. To provide an exit it would be necessary to tunnel under Mont Blanc. The Genevans have contemplated this solution, but it is blocked by the breadth (30 kilometers) and the height of the mountain (3800 meters above the valley of Chamonix). Furthermore, to make the line useful to other places it would be necessary to complete it by a line from Faucille under the parallel chains of the Jura. While these grandiose projects are awaiting development, the Arve remains an easy way of penetration into Savoy.

THE FREE TRADE ZONES

The geographical relationships between these several regions, the Pays de Gex, Geneva and its lake, and Upper Savoy have been frequently recognized in political history. The treaty of St. Julien (July 31, 1603) established the principle of freedom of trade between Geneva and the Duchy of Savoy, the Genevans being exempt from all taxes, tolls and customs duties. France recognized the same right of exemption for Genevans in relation to the Pays de Gex (May 25, 1602). At the Restoration Geneva demanded revival of these rights, which naturally had been suppressed during the incorporation with France. The free zone of Gex was re-established (by the Treaty of Paris, November 20, 1815), the line of French customs posts being moved back to the west of the Jura. The Treaty of Turin (March 16, 1816) established a similar free zone on the left bank of the Rhone, the "petite zone sarde" with a width of four or five kilometers. In addition it allowed freedom of passage for all necessary provisions for the town and canton of Geneva. In 1860 Savoy was ceded to France. Switzerland protested against the treaty of annexation in respect of the neutralized provinces of Chablais, Faucigny, and Genevois. A plebiscite held to ascertain the wishes of the population showed a considerable number of adherents to Switzerland, but the popular vote was for France. Under the slogan of "Oui et zone," the result was incorporation in France with the creation of a new free zone, the "grande zone de Savoie," or the "zone of annexation," including Chablais, Faucigny, and a small part of Genevois beyond which was established the French customs barrier.

It was under this regimen of free zones that Geneva, the Pays de Gex, and Upper Savoy continued until 1914, the situation changing little in a century. On the Swiss side incorporation in that country has made Geneva a Swiss region with closely knit relations in intellectual, economic, and political matters.

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[1] See the biography of De Saussure by Douglas Freshfield with the collaboration of H. F. Montagnier, reviewed in the *Geogr. Rev.*, Vol. 12, 1922, pp. 519–520.

On the French side sixty years of common life with France have effaced the particularism of the Savoyard. The common sufferings and losses of the world war—Savoyards furnished the major part of the heroic battalions of the *chasseurs alpins* (the "blue devils")—have cemented the new province to France. Savoy has taken on an extensive industrial development and looks for protection against Swiss competition.

During the war a police cordon was drawn round the political frontier, which considerably impeded intercourse between France and Switzerland. Prohibition of export of foodstuffs was made on both sides, and Geneva had to find its requirements in the neighboring Swiss cantons, more particularly in the canton of Vaud.

In consequence of these wartime developments and in pursuance of the general French policy towards administrative unification France on the conclusion of peace suppressed the "grande zone"—to the satisfaction of the population concerned—and inserted in Article 435 of the Treaty of Versailles a denunciation in principle of the "petites zones" and the neutral zone, the abrogation of which was accepted by Switzerland with reservations (see the annex to part XV of the Treaty). The convention of August 7, 1921, between France and Switzerland, upon which the verdict of the Swiss people is forthcoming, carries the line of customs ports to the political frontier and thus suppresses the free zones.[1] To ease adjustment to new conditions it is provided that for a period of ten years the inhabitants of the Swiss cantons of Geneva, Vaud, and Valais bordering Lake Geneva shall enjoy a part of the commercial facilities with the old zones, including the great zone of 1860. The special situation of the canton of Geneva with the district of Nyon (Vaud) bordering the Pays de Gex and the commune of St. Gingolph (Valais) is also recognized, special advantages of transportation and supply being accorded for an indefinite period.

The new state of things, whether with or without the privileges of the convention of August 7, 1921, shows again the influence of railroads and other means of rapid communication on the expansion of economic and commercial relations from the narrow limits of local circumstance to national and international scope. It also gives an interesting illustration of the evolution of the idea of the frontier—at first a band of country, or zone, then progressively narrowing until it becomes at last no more than a line.

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[1] Since the above was set up in type the cantonal voting has taken place. By a strong majority vote the proposed customs agreement has been rejected, and other negotiations will be necessary (see *Econ. Rev.*, London, March 16, 1923, p. 231, and April 20, p. 338).—EDIT. NOTE.

THE NEW RUMANIAN STATE

REGIONS AND RESOURCES

By E. M. Sanders
Furzedown College, London

Rumania is one of the most vigorous of the newer states of post-war Europe. Before the war she had shown very considerable progress based in large measure on the rapidly growing importance of oil as fuel, of which commodity she possessed notable resources. Since the war the new boundaries have further added to her status (Fig. 1). Except on the south, where the Danube forms the confines, she has advanced in all directions. Her area has been more than doubled (113,600 square miles), and from an awkwardly disposed territory she has become one of the most compact of states.[1] A consideration of the present position of Rumania may be best begun with an account of the natural regions comprised within her new boundaries.

The Natural Regions

A general idea of the natural regions of Rumania which are shown in the map (Fig. 2) may be gained by traveling through the country from the west to the southeast. In such a journey one first passes through a transition region comprising a narrow zone of fertile river plains adjoining Hungary. This is better represented in the south, in the Banat, where intensive farming is practiced. Then a region of high broken contour is circumvented, the Bihar block, along whose borders one may see mining towns, although the greater part of the population is still working on the land. Next a part of the Transylvanian basin is crossed—undulating country composed of a series of fertile basins surrounded by wooded hills. From Transylvania one runs into the high mountains, the Carpathians, in places reminiscent of the Alps with bare rugged peaks and unsurmountable slopes but elsewhere, and especially in the central portion of the arc, recalling rather the Juras with wooded slopes and smooth grass-clad summits. Down the other side of the mountains the region of foothills is entered. Here in a smiling landscape where numerous valleys are flanked by low wooded hills one may see ancient and modern Rumania living side by side. Ancient Rumania is typified by the illiterate peasant living in his little wooden house so brightly painted, working his own field, in his own way, carrying on the age-old traditions. Modern Rumania is typified by the oil wells or by the aerial railway that brings down timber from the hills to the paper mills. From the foothills the road runs on to the plains of the Lower Danube—endless flat land for the most part treeless. Wide fields where crops are growing for export flank the roads. On the plain lie cities which serve as collecting and distributing centers for the region. Passing the towns one goes on again over the never-ending steppe, which becomes more parched as one journeys eastward. The Danube is a welcome change, the neighboring marshes and the many broad branches of the river affording refreshment after the dusty plain. In the southern part of the Dobruja, which succeeds the plain, the land becomes more accidented without becoming more interesting. A bare limestone plateau crossed by wide dry valleys, as parched as the steppe, continues on to the coast. Here modern Rumania meets one again in the grain elevators and oil storage tanks of the growing port of Constantsa.

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[1] Emmanuel de Martonne: La nouvelle Roumanie, *Ann. de Géogr.*, Vol. 30, 1921, pp. 1–31.

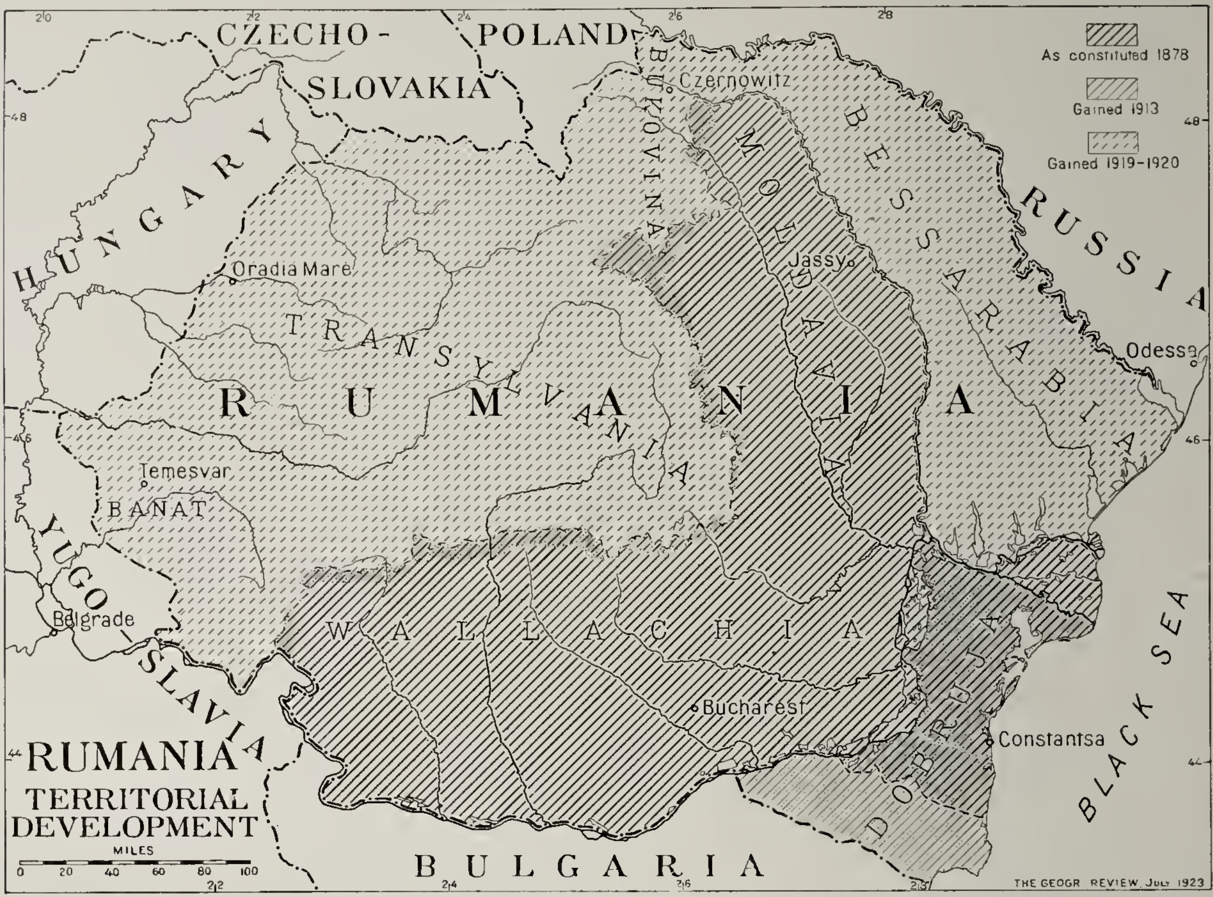

Fig. 1—Map showing the territorial growth of Rumania from the recognition of independence by the Congress of Berlin, 1878, to the establishment of the present boundaries by the treaties of St. Germain with Austria, (1919), Neuilly with Bulgaria (1919), Trianon with Hungary (1920), and the declaration of the Great Powers, London, 1920, recognizing Rumania's claim on Bessarabia. (On earlier political limits see the map "Der rumänische Volksboden und die staatliche Entwicklung des Rumänentums," Pl. 35, *Petermanns Mitt.*, Vol. 61, 1915.) The stippled area represents the territory Rumania was required to cede by the Treaty of Bucharest, 1918 (see the map "Gebietsabtretungen Rumäniens an Österreich-Ungarn und Bulgarien," Pl. 8, *Petermanns Mitt.*, Vol. 64, 1918), which treaty, however, was never signed and was abrogated by the conclusion of the war. Scale of map 1: 7,000,000.

Let us examine each of these natural regions more closely.

The Mountains of the Carpathian System[2]

The most striking feature of the build of Rumania is the great arc of high mountains which forms the backbone of the country. These mountains of the Carpathian system go under different names in different parts. The section running from the Danube eastward, known as the Transylvanian Alps, merits its name by certain similarities with the Alps of Switzerland. Here may be found lofty jagged peaks, indented by glacial cirques, with lakes and cascades. The mountains as a whole, however, are neither so high nor so continuous a barrier. More characteristically they rise to rounded plateau-like summits penetrated by deep valleys, some of which cut a passage through the chain. East of the Predeal Pass the chain swings northward under the name of the Moldavian Carpathians. Scenery changes as well as direction. The ancient crystallines of the western section are replaced by weaker rocks. Here the Alpine type of scenery is entirely lacking. Altitudes are lower: the mountains present a maze of flat-topped summits with rounded wooded flanks. In the extreme north of the chain, the Mountains of Bukovina, the Alpine type again appears.

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[2] See Emmanuel de Martonne: Recherches sur l'évolution morphologique des Alpes de Transylvanie (Karpates méridionales), *Rev. de Géogr. Annuelle*, Vol. 1, 1906–07, pp. xi–xxi and 1–279; *idem:* The Carpathians: Physiographic Features Controlling Human Geography, *Geogr. Rev.*, Vol. 3, 1917, pp. 417–437.

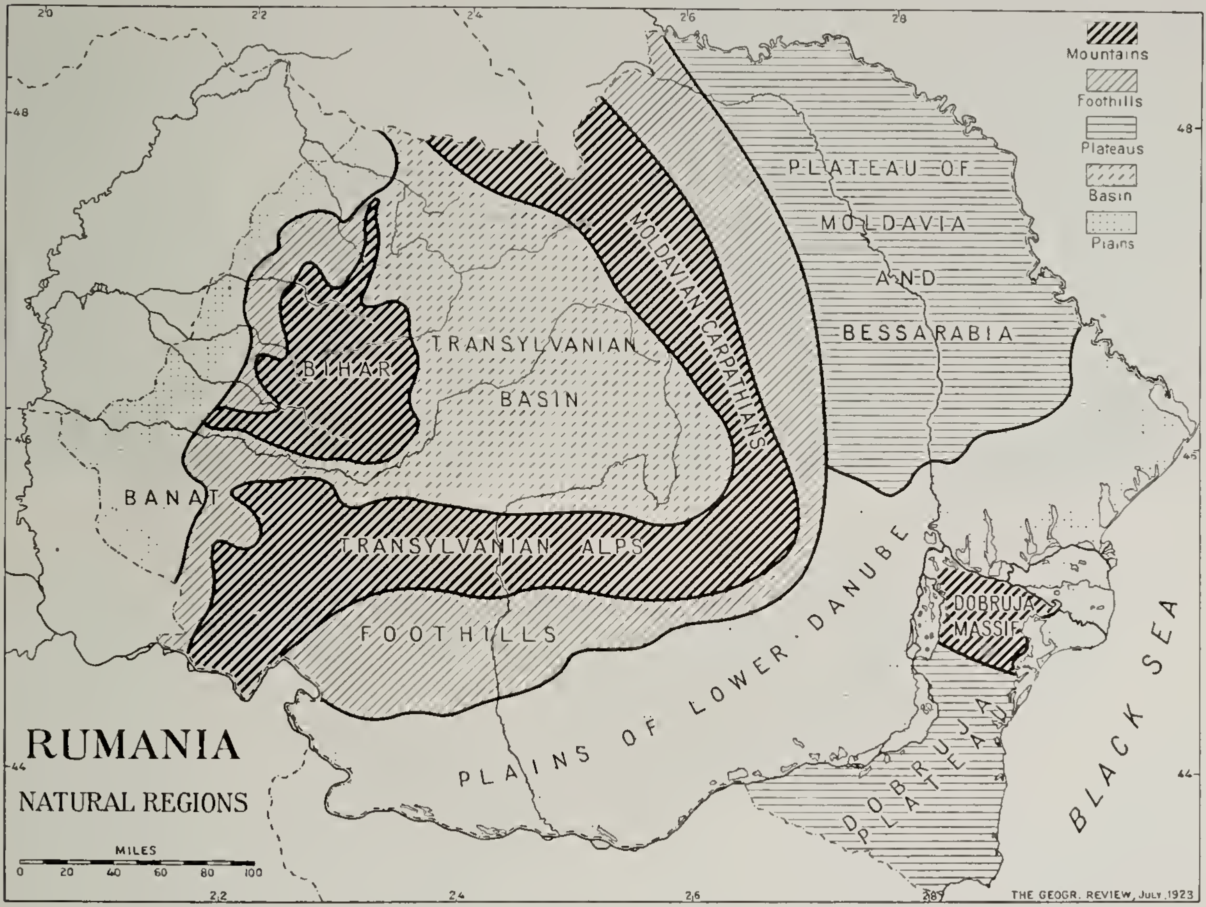

FIG. 2—Map showing the major natural regions of Rumania. The boundaries of the regions are drawn diagrammatically. Based on G. Murgoci and I. Popescu-Voiteshti: Carte géologique de la Roumanie et des contrées limitrophes, 1:2,500,000; G. Murgoci and I. Popa-Burca: Harta Fizica a României, 1:2,500,000 (accompanying Geografia României, New Ser., 3rd edit., Bucharest, 1921); E. de Martonne: Physiographic Map of the Carpathians, 1:2,500,000, *Geogr. Rev.*, Vol. 6, 1917, Pl. IV; and other sources. Scale of map 1:7,000,000.

Such is the continuous arc of mountains which encircles the basin of Transylvania on its southern and eastern sides. The Bihar massif completes the mountain girdle of the basin on its western side. This block has been left standing while the surrounding land has subsided. A steep escarpment

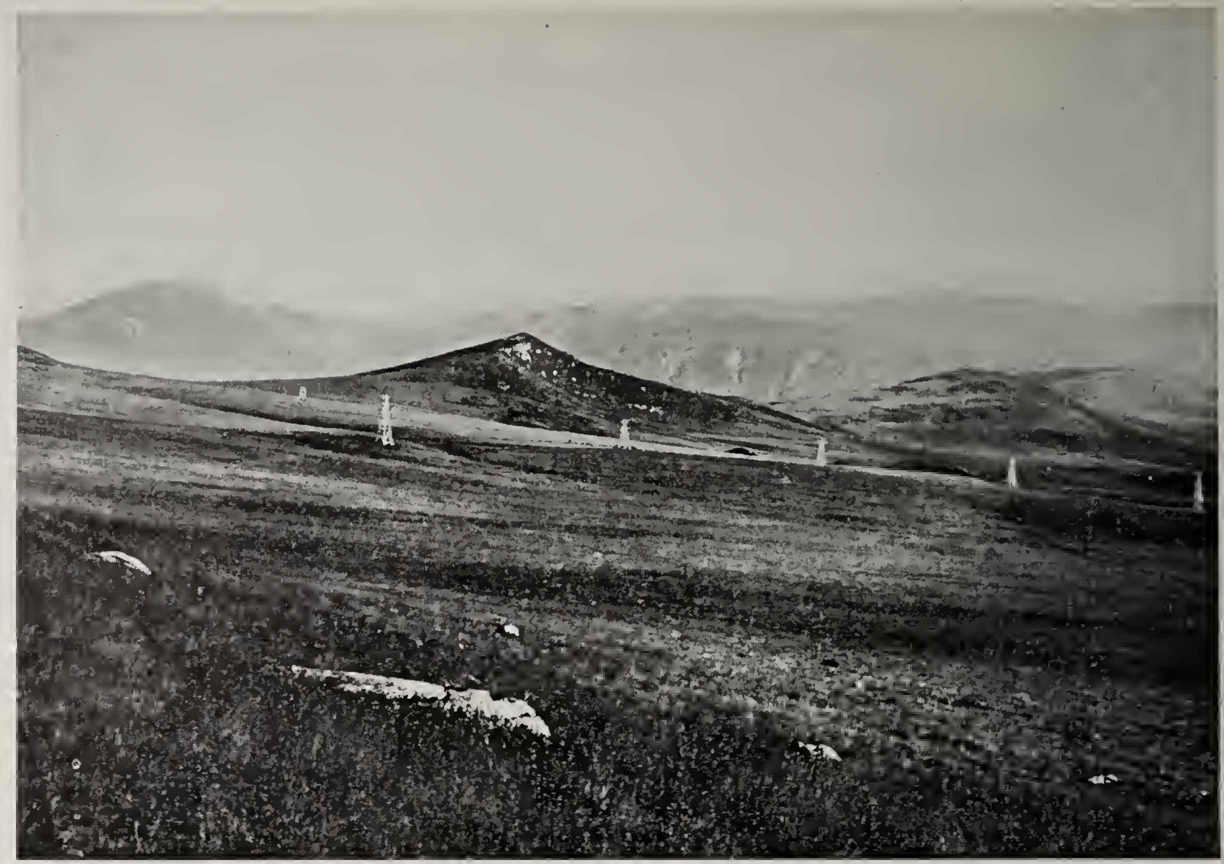

Fig. 3

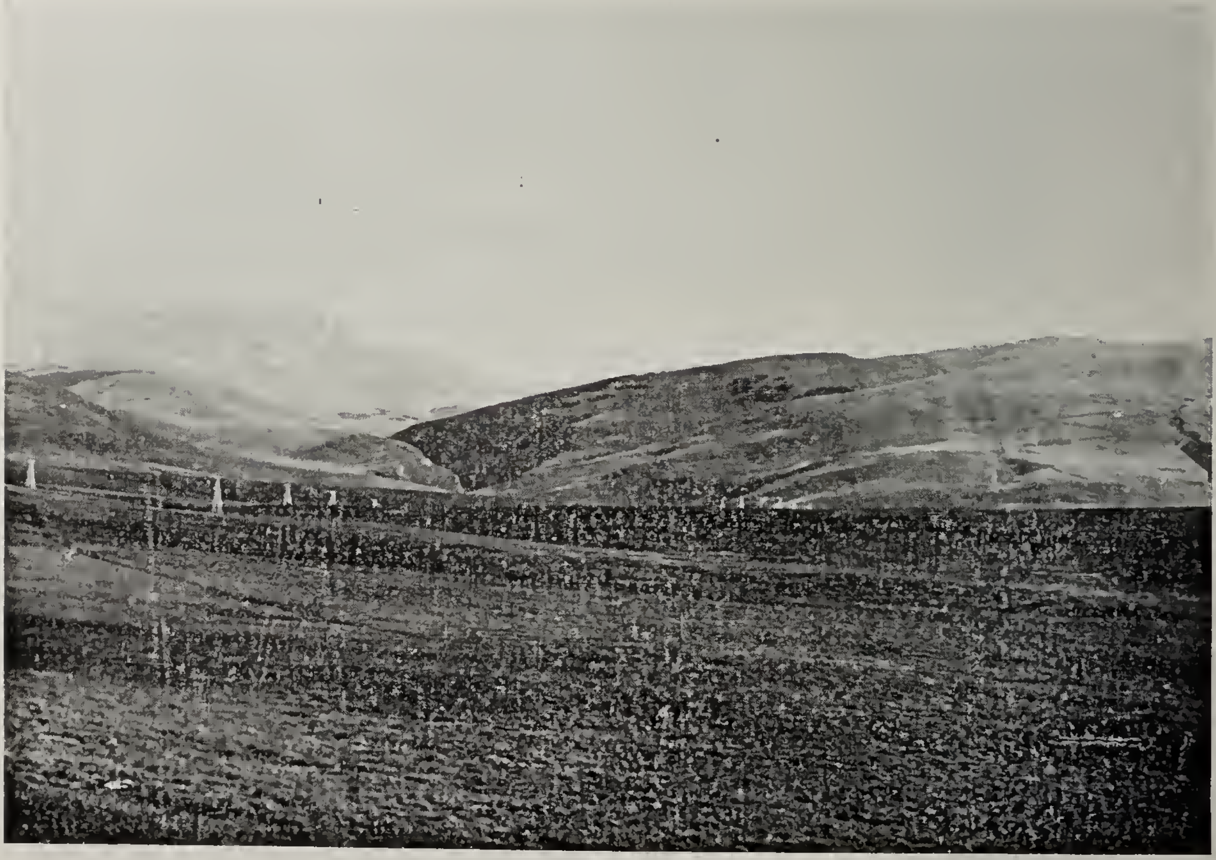

Fig. 4

Figs. 3 and 4—Plateau-like summits in the Bucegi massif. Note the aerial railway for carrying down timber. The Bucegi massif, lying between the Dambovitsa and Prahova valleys, is a transition region between the Transylvanian Alps and the Moldavian Carpathians. It is especially interesting for the highly varied forms of relief exhibited. (Photographs by M. Harret, Sinaia.)

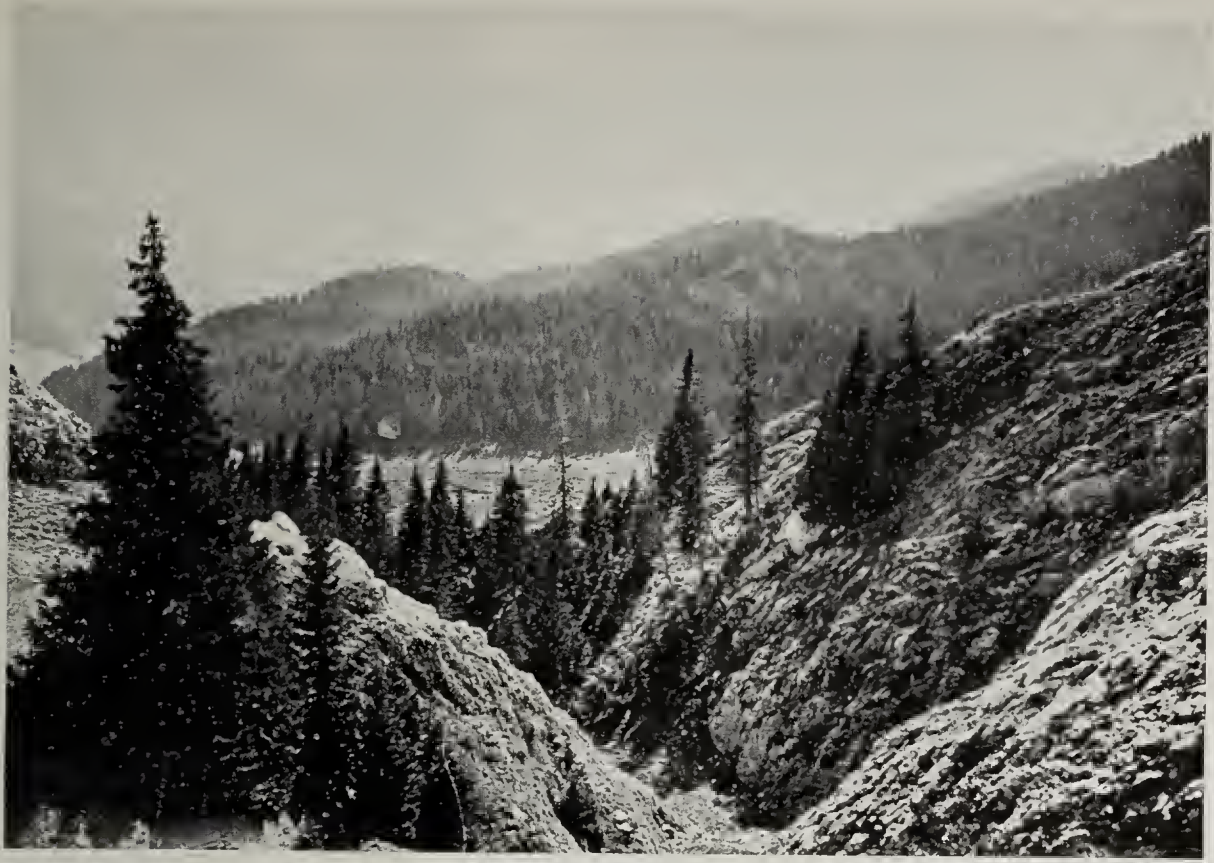

Fig. 5

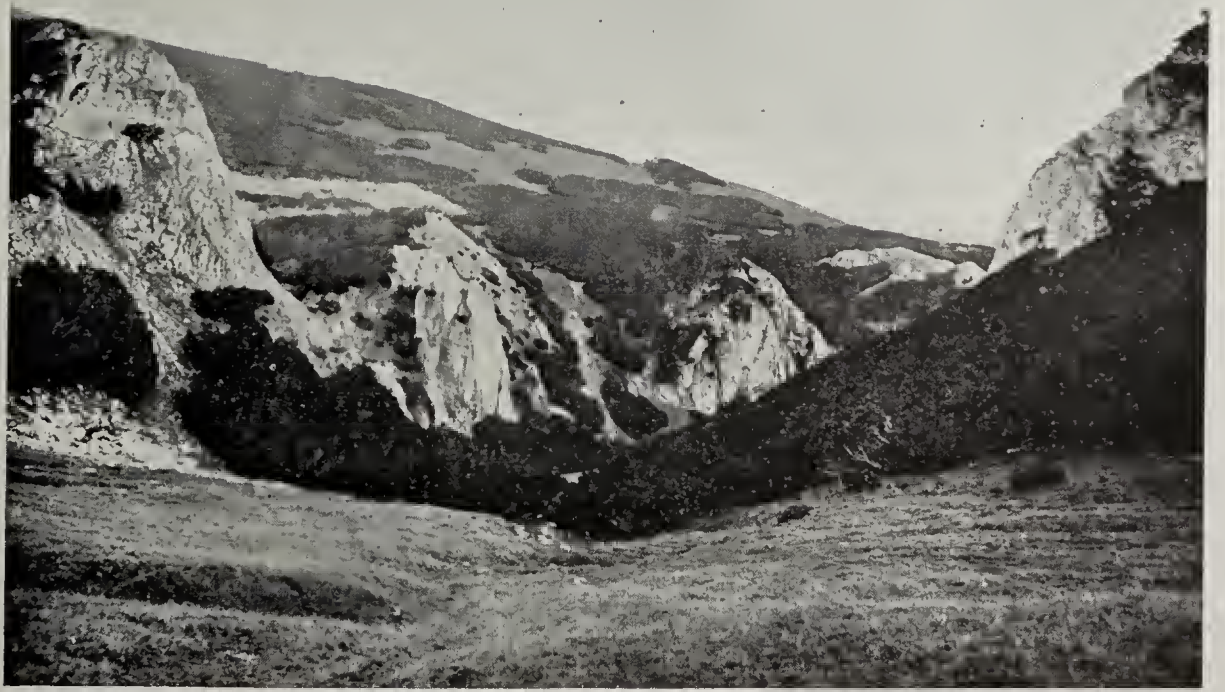

Fig. 6

Figs. 5 and 6—The Jura type of relief is seen in this part of the Bucegi massif. Figure 5 is in the upper valley of the Jalomitsa. The amphitheater formed by the headwaters of this stream is richly wooded to high altitudes. Figure 6 shows the head of a gorge. (Photographs by M. Harret, Sinaia.)

frowns over the valley of the Mures beyond which there stretch plateau-like summits deeply cut by streams and diversified by volcanic relief.[3]

The mountains of the Carpathian system have been the greatest boon to Rumania in the past, for here her persecuted people have fled in times of trouble. Numberless fertile valleys are still occupied by Rumanian farmers, descendants of these fugitives and representatives of the purest Rumanian type. Not only in the past but at the present the mountain zone is a great asset. The forests which clothe the flanks provide the material for one of the most promising of the growing industries, while the proximity of arid lands such as Egypt and large portions of the Mediterranean coastal regions make timber valuable as an article of commerce.[4] Further, the mountain streams provide the power to drive many mills. The age-old practice of transhumance, that is, the driving of flocks up to summer pasture and the return to winter in the lower land, still continues and provides a valuable link between the opposing flanks of the chain. Although the mountains themselves have no valuable mineral wealth except building stone, yet the same processes which formed the mountain chain are responsible for the mineral wealth which is found along their borders.

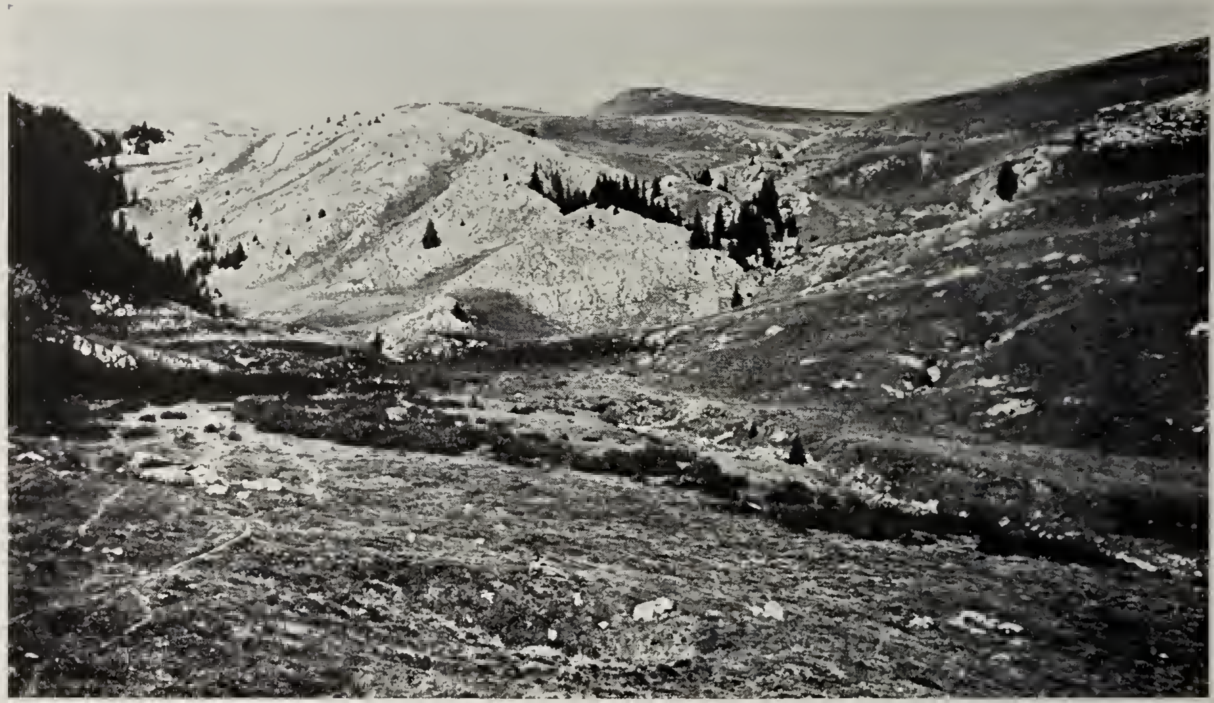

Fig. 7—Karst type of country in the Bucegi massif. (Photograph by M. Harret, Sinaia.)

The Mountains of the Dobruja

Distinct from the Carpathians in structure as well as position is the mountainous mass of the northern Dobruja.[5] It seems to be an isolated overthrust of the same system as the mountains of the Crimea. The summits are wooded, and copper has been mined on the northern edge of the mountains; but their chief commercial importance at present is as a source of building stone.

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[3] Emmanuel de Martonne: Le massif du Bihar (Roumaine), Étude morphologique, *Ann. de Géogr.*, Vol. 31, 1922, pp. 313–340.

[4] According to official Rumanian figures 20 per cent of the export of timber and timber products in 1913 went to Egypt and 12 per cent to Turkey.

[5] See the interesting block diagram by G. Vâlsan: Câmpia Română, *Bul. Soc. Regale Române de Geogr.*, Vol. 36, 1915, pp. 313–568; reference on p. 524.

Foothills of the Mountains of the Carpathian System

The Carpathian foothills of Rumania (including the foothills of the Banat), the extent of which is shown in Figure 2, are in many ways the most interesting part of the country. The hills, which rarely exceed 600 meters (2000 feet), are the remains of a dissected plateau. The valleys are from 250 to 100 meters (800 to 300 feet) deep. They are exceedingly fertile and are well sheltered, separated but not isolated by the surrounding wooded heights. Conditions of safety, varied resources, comparative ease in gaining a living, with possibilities of intercommunication have supported a marked development of the characteristic Rumanian culture of the foothills. The costumes, embroidery, legends, and customs in this region bear witness to the individuality and wealth of this culture. The density of population is very great in some of the chief valleys of eastern Wallachia (Mutenia) and in the so-called sub-Carpathian depression which in places separates the mountains proper from the foothills.[6]

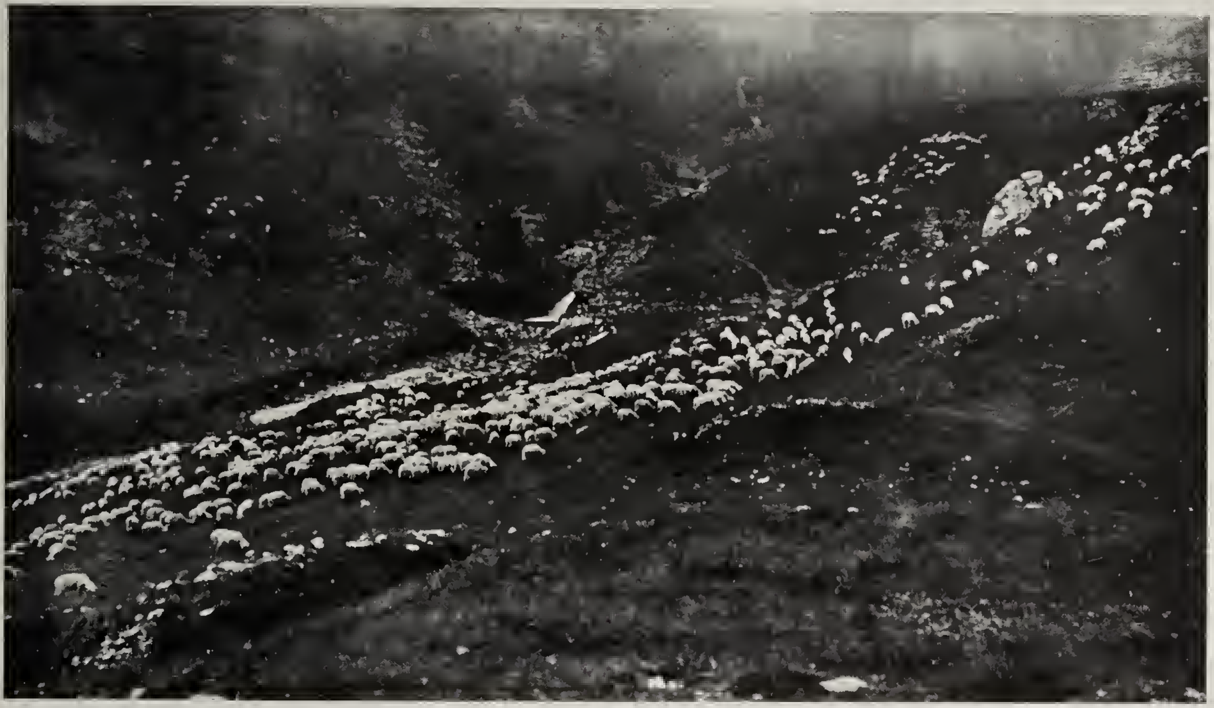

FIG. 8—Sheep in the Carpathians at an altitude of 7500 feet. The Caraiman plateau, Bucegi massif. (Photograph by M. Harret, Sinaia.)

Such has been the rôle of the foothill region in the past; at the present time it still is one of the most important regions, for here is found Rumania's most remarkable asset, petroleum. The characteristic scenery of the foothills, the gay wooden houses of the Rumanian peasant, surrounded by fields of maize, with a flock of sheep on the near-by hillside and the cumbersome slow-moving oxcart, is suddenly replaced by an unsightly compound of temporary premises, with high pumping apparatus, chimneys, and rubbish heaps, while over all there lingers the smell of oil.

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[6] Emmanuel de Martonne: La Valachie: Essai de monographie géographique, Paris, 1902.

THE BASIN OF TRANSYLVANIA

The region of moderate relief second in importance is the basin of Transylvania. This area of relative depression, which lies however at a fairly high altitude, is itself broken up into a number of basins by low wooded hills. The hills are the remains of a much more accidented region; they have not only been worn down by erosion but also have been half submerged by the eroded material. There is similarity of structure but difference in the proportion of hill to plain as one journeys from north to south in Transylvania. Towards the north the hill gains on the plain, the stretches of flat land become smaller, and the general character of the scenery more undulating.

Transylvania is one of the most productive parts of Rumania and at the same time one of her greatest problems. The climate in summer is hot enough to ripen maize and grapes. The presence of timber, abundance of streams, sufficient rainfall, and fertile soil have always made of Transylvania an attractive region, and people have been drawn in from all the surrounding lands during all periods of history.[7] Mineral wealth has but added to the general diversity of the population. Rumanian hamlets or isolated farms, big German villages, straggling Hungarian towns come into sight one after another; every valley is occupied. To the Rumanian state Transylvania has brought agricultural products, salt, coal, iron and gold mines; but with them there is an ethnic problem of the greatest difficulty.[8]

THE PLATEAUS OF MOLDAVIA AND BESSARABIA AND THE SOUTHERN DOBRUJA

The plateaus of Moldavia and Bessarabia resemble in structure the foothills region; but the climate is more arid, the loess-covered surface is greedy of water, and in consequence a very different landscape is presented. The wooded area is reduced as one journeys toward the east. The valleys also become broader and shallower. Agriculture is exceedingly profitable in the river plains, but the upland surface is far more monotonous and bare than in the foothill region.

The plateau of the southern Dobruja, still more arid, is essentially a steppe country. It is a limestone region characteristically deficient in surface streams, and, as in the country north of the Danube delta, the lack

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[7] On the historical aspect see an interesting paper by James Berry: Transylvania and Its Relations to Ancient Dacia and Modern Rumania, *Geogr. Journ.*, Vol. 53, 1919, pp. 129–152. Note especially the map of boundary dikes (Fig. 14) and the photograph (Fig. 10) of one of the characteristic fortified churches of southern Transylvania.

[8] Cf. B. C. Wallis: The Rumanians in Hungary, *Geogr. Rev.*, Vol. 6, 1918, pp. 156–171.

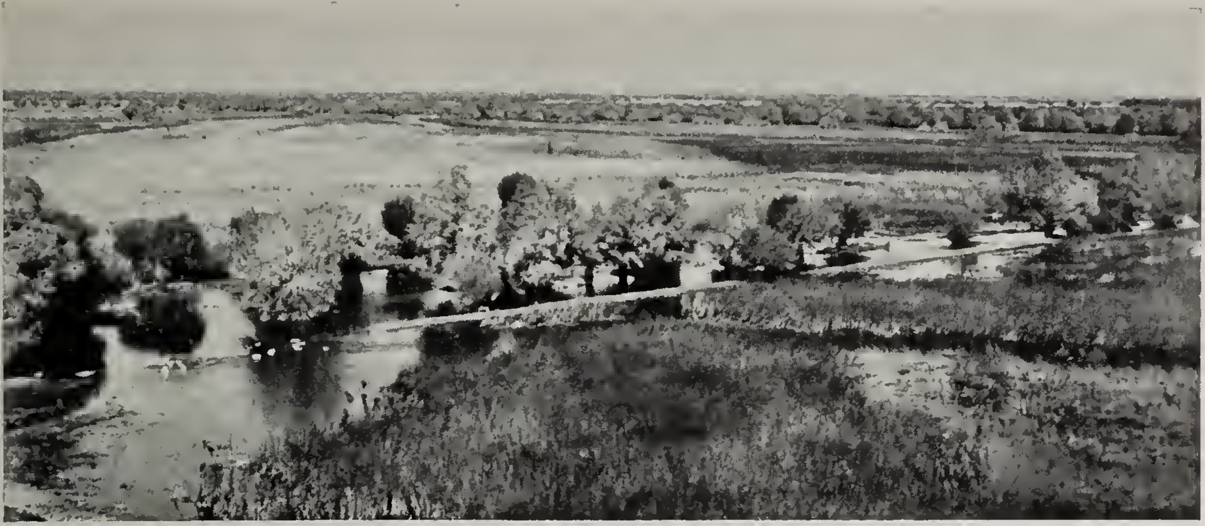

Fig. 9

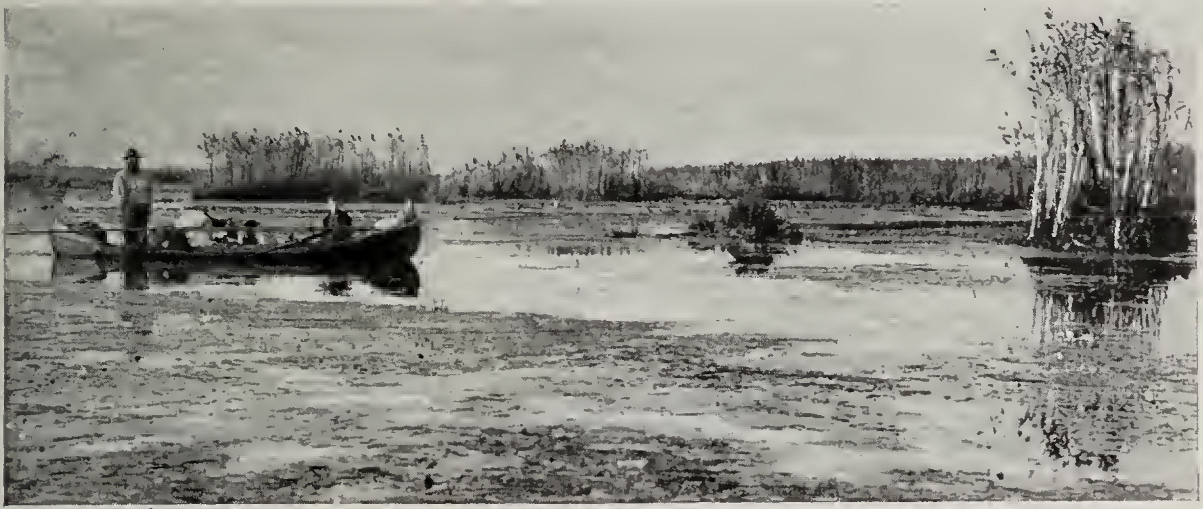

Fig. 10

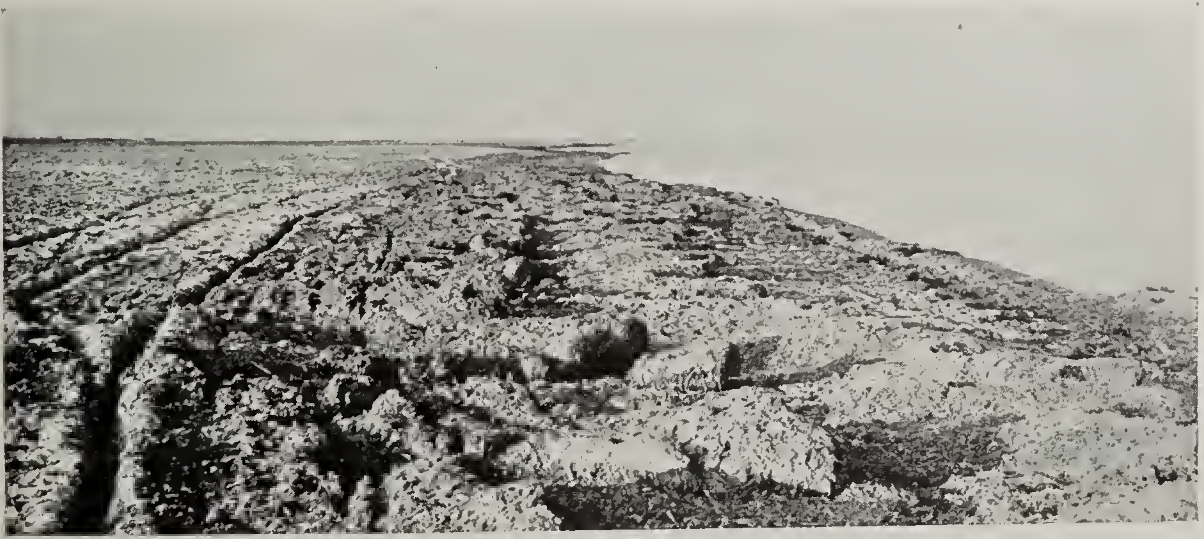

Fig. 11

Fig. 9—Looking across the Danube valley (head of the delta) towards Ismail. (Photograph by Miss M. Pallis.)

Fig. 10—In the Danube delta. Most of the fishermen here are Lipovans, a religious sect emigrated from Russia. (Photograph by Miss M. Pallis.)

Fig. 11—Coast of the Black Sea north of Sulina, sea-drifted peat and sand. (Photograph by Miss M. Pallis.)

of water is rendered even more distressing by the covering of loess which is raised up as dust by tempestuous storms in the dry hot weather. A serious attempt is being made to develop agriculture in this region, for there is usually enough rain in spring to start the wheat, and the district round Constantsa is now producing sufficient for export.

The Plains

Mountain, hill, and plateau contribute to the wealth of Rumania; but always the plain stands first in importance, for on the plain are to be found the great wheat fields that make of Rumania one of the export granaries of Europe. In addition to the plain of the lower Danube, which continues into Bessarabia, is a narrow strip of plain on the western edge of Transylvania.

Plains of the Transylvanian Border

The plain on the border of Transylvania is the eastern fringe of the Alföld, the great plain of Hungary. The northern portion is comprised by the districts of Maramuresh and Crishana, the southern is a part of the Banat. Exceedingly fertile, well watered, tilled, and fertilized, it is one of the most productive regions of new Rumania. Here, however, is one of Rumania's grave problems in the large Magyar and other alien elements in the population.

Plains of the Lower Danube

The plains of the western border comprise but a small area compared with the great plain of the Lower Danube. This plain may be divided into eastern and western parts. The western part has sufficient rainfall to support a natural vegetation of rich grass, and here wheat and maize thrive excellently. As one travels towards the east the land becomes drier, and the natural vegetation is poor; but with careful cultivation wheat is profitably raised for the soil is exceedingly rich. In the great plains of Old Rumania one sees large-scale cultivation with machinery which, with the exceeding flatness of the land and the continental type of climate, recalls the Middle West of North America. Bucharest has a temperature regimen similar to that of Chicago, but one degree warmer, and an annual rainfall of 23 inches against 33 inches for the American city. The Danube delta has less than 15 inches of rainfall.[9]

These are the several natural regions comprised within the borders of the New Rumania. They bring together a variety of resources such as constitute the foundation for an exceedingly well-balanced state. We may now inquire as to the manner of their utilization.

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[9] See the rainfall map by E. Otetelizanu and G. D. Elefteriu in *Bul. Soc. Regale Române de Geogr.*, Vol. 39, 1920, facing p. 222.

Utilization of National Resources

Land Tenure

We shall start with agriculture, for Rumania is essentially an agricultural country. First a word must be said as to the system of land tenure, as this has recently been modified with far-reaching results.[10]

Until 1864 Rumania had much the same system of land tenure as Russia; that is, a few landowners held the farming peasantry in a state of serfdom. At that date the peasants were freed; and the property of the monasteries, a matter of 4,000,000 acres, was expropriated and distributed among 400,000 peasants. In 1889, after a rising of the peasants, further relief was given by the division of the state lands, comprising about one third of Old Rumania. These lands were sold in lots to the peasants. In 1907, however, discontent provoked another revolt, and measures were again taken to reduce the size of the large estates for the benefit of the people. The peasants' holdings were still too small for their needs, and in 1912 and in 1914 there were disorders followed by further measures in the same

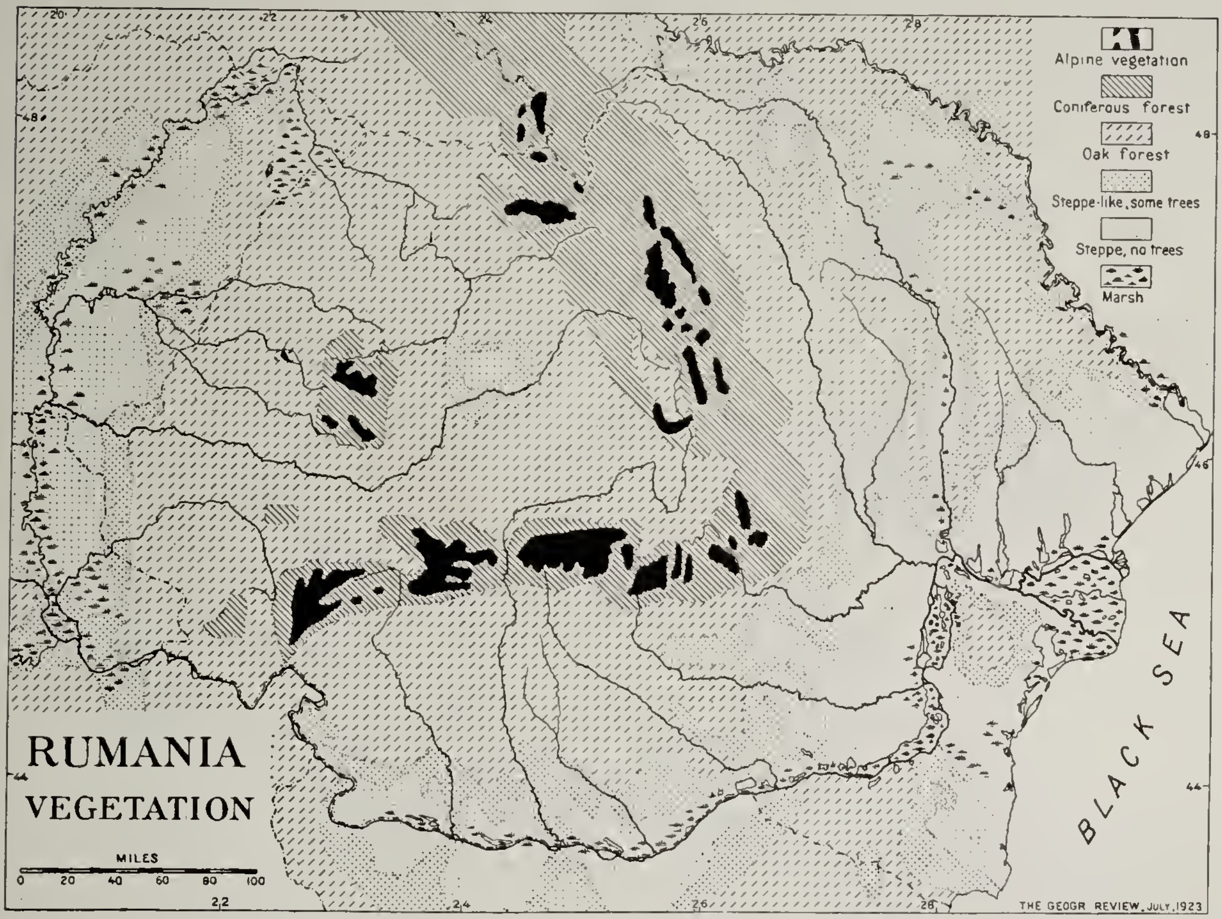

FIG. 12—Map showing the vegetation of Rumania. After G. Murgoci and I. Popa-Burca: Geografia României, New Ser., 3rd edit., Bucharest, 1921, map on p. 104. A larger-scale map (1:1,500,000) of the vegetation of the Old Kingdom after P. Enculescu is given in E. Nitz: Militärgeographische Beschreibung von Rumänien, Berlin, 1919. See also the maps of soils and woods in this volume. Scale 1:7,000,000.

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[10] G. Jonescu-Sisesti: Agrarian Reform and Agricultural Production in Roumania, "*Manchester Guardian Commercial*," *Reconstruction in Europe*, 1922–23, p. 514; *idem:* Land Reform in Roumania, *ibid.*, pp. 373–375.

direction. The status before the war may be summed up thus: large estates (that is estates exceeding 100 hectares, or 247 acres) formed 48 per cent of the cultivated area in Old Rumania, 45 per cent in Bessarabia, 34 per cent in Transylvania, 60 per cent in Bukovina. At the same time the average holding per family was 3.2 hectares in Old Rumania, 4.4 hectares in Bessarabia, 3.2 hectares in Transylvania, 1.4 hectares in Bukovina.[11] Acts have been passed to reduce the estates and Crown Dominions in Old Rumania still further, limiting them until they only occupy 8 per cent of the total arable land, and to expropriate the large landowners of Transylvania and Bessarabia.[12] Besides the division of large estates among peasant proprietors measures have been taken to give over large tracts of land to peasant associations for cultivation and common pasturage. The Rumanian Minister of Agriculture, speaking in May, 1922, said that "five million hectares of arable land have passed from the hands of the large owners into those of nearly one and a half millions of heads of peasant families." He added that when the reform was carried through, "out of a total of 13 million hectares of arable land possessed by Greater Rumania, 12 million will have definitely passed into the hands of about 4 million peasants, in separate lots varying from 1 to 5 hectares according to the region and the density of the population. One million hectares only will remain in the hands of about 6000 owners, an average of from 100 to 200 hectares per head . . ."[13]

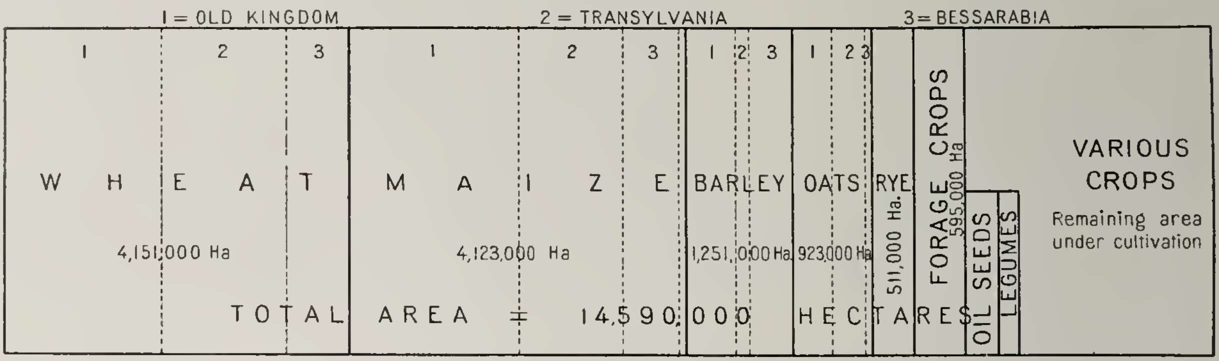

FIG. 13—Diagram showing the acreage of crops in Rumania. Based on a table in "La Roumanie économique," 1921, p. 12 (with correction of an error in the figure for maize in the Old Kingdom).

AGRICULTURE

Agriculture is still the main industry of the country, not only supporting the inhabitants but also furnishing the chief exports. Three-quarters of the inhabitants of Rumania are employed in agricultural pursuits, and the greater part of these are engaged in crop raising: 45 per cent of the land is arable. From Figure 13 it is evident that wheat and maize are the two chief crops by a long way. The districts that contribute most are Old Rumania and Transylvania, with Bessarabia a good third. The contribution of Bukovina was in each case too small to plot effectively. The figures from which the diagram was constructed give only the area under each crop; the amount produced per acre varys a great deal according to the fertility of the land and the methods of cultivation. In Bessarabia, for example, the average yield of wheat is not more than 13 hectaliters to a hectare, while in Old Rumania the figure is from 15 to 18; and in parts of Transylvania, for example the Banat and the plains of Arad, the yield is higher still. The average for all Rumania is 15.7.

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[11] La Roumanie économique, 1921, Office des Études et Enquêtes, Ministère de l'Industrie et du Commerce, Bucharest, 1921, p. 10.

[12] *Ibid.*, pp. 24–25.

[13] H. M. Conacher: Agrarian Reform in Eastern Europe, *Internatl. Rev. of Agric. Economics*, Vol. 1 (N. S.), 1923, Rome, pp. 3–18; reference on p. 15.

Wheat is grown largely for export. The staple food of the peasants is maize, which, however, also contributes substantially to the exports.

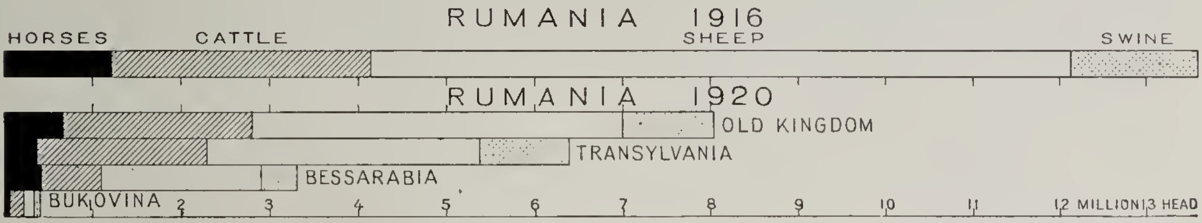

FIG. 14—Diagram showing distribution of live stock in the major political division of Rumania after the war (figures from *Correspondance économique*, Bucharest, July, 1922, pp. 5–6). Figures for the Old Kingdom before entry into the war are given for comparison (from La Roumanie économique, 1921).

Division of the large estates among the peasants probably means that more maize will be grown and consumed in the country and less wheat will be grown and exported. Further, a general decrease in yield is inevitable. Even if the peasants could co-operate to use machinery the peasant-proprietor system must make the raising of extensive crops for export difficult, especially while the level of education of the peasant is as low as at present. As a matter of fact the peasant has not yet reached the stage of wishing to use machinery for farm work. Oxen plow and drag his carts, and fertilizers beyond those furnished by the farm itself are unknown to him. The greater yield per acre of the Banat is due to the use of chemical fertilizers, and the large estates of the plains of Old Rumania have furnished proof of the wonderful utility of machinery in dealing with large areas on the plain and in combating the loss that is likely to occur from unfavorable weather. Thus it is to be hoped that in time the peasants may combine and bring their farming methods more up to date. Already some of the peasant co-operative societies have a system of lending certain agricultural machines.

The variability of returns in agriculture is a very serious question. Rumania is on the borderland between well-watered western Europe and the arid lands of southeastern Russia and the Near East. A slight variation in rainfall means serious loss; for example a slight reduction in the spring rains when the young plants are growing or a slight increase in summer when the grain is forming may ruin the crops. In the newer small holdings

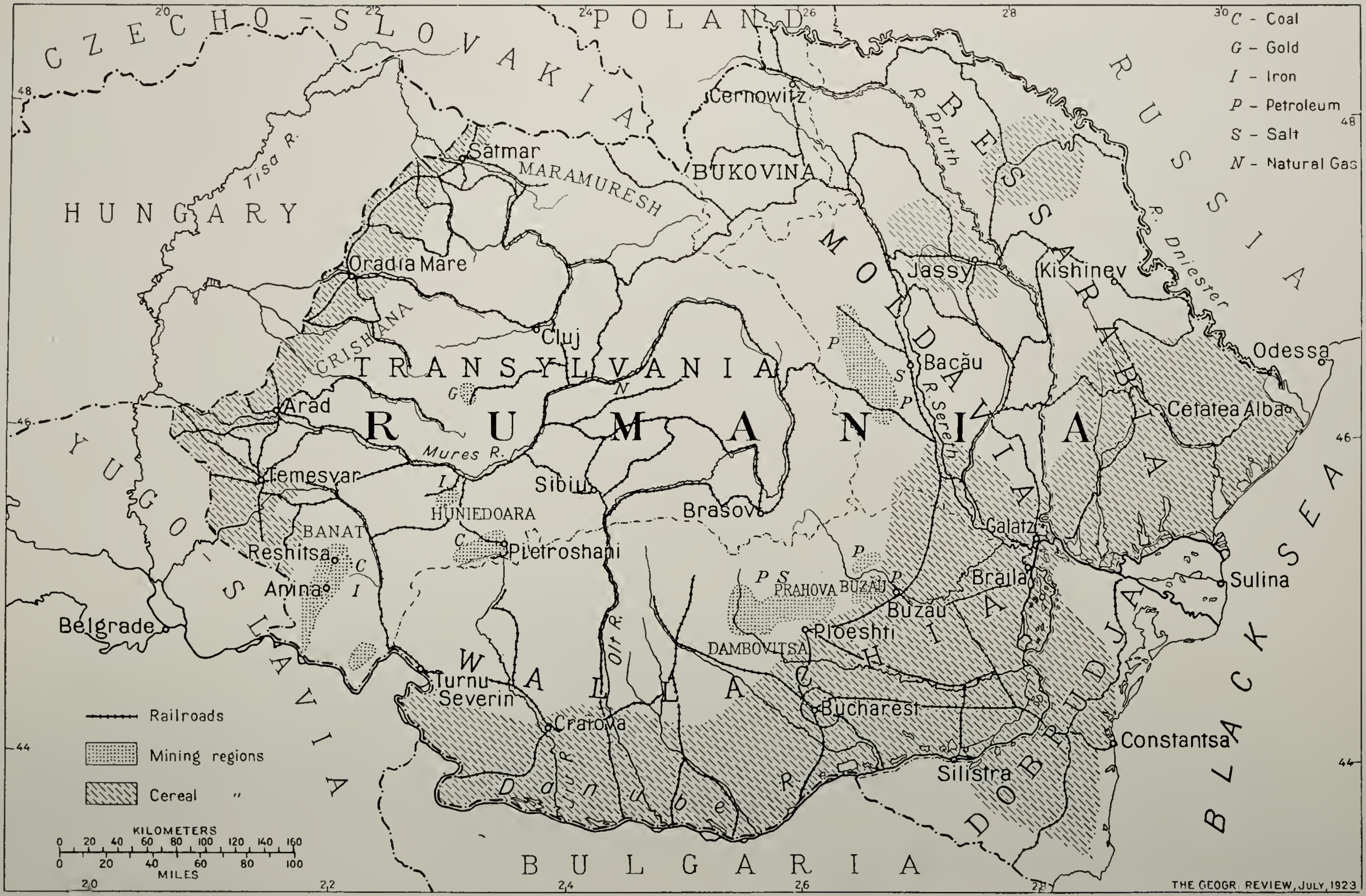

FIG. 15—Map of Rumania showing the chief towns (industrial centers, ports, and grain *entrepôts*), grain-producing areas and mining regions (following in part the map accompanying M. de Martonne's article cited in footnote 1), and railways. Scale approximately 1:5,000,000.

there is not the same possibility of tiding over a bad year as there was on the large estates. Again it looks as if co-operation were the only way out of the difficulty.

Animals, hides, skins, wool, and hair all figure in the list of exports; but compared with grain they are unimportant. For the people of the country, however, live stock is an essential part of the farm economy, especially oxen, which are the draft animals. The peasants do not eat much meat, and as a rule its production is for the neighboring towns. In the cattle industry, Transylvania leads, if the number of cattle is considered with regard to the number of inhabitants. In 1917 there were 440 cattle for every 1000 inhabitants. Nor did Transylvania suffer in the war in loss of cattle as did Old Rumania, who found herself crippled for want of draft animals when the war came to an end. Transylvania also has more sheep per head than have other parts of the country; she has 790 for every 1000 inhabitants. The relief of a large part of Transylvania makes shepherding a more profitable occupation than agriculture; while the plains of Old Rumania are agricultural land *par excellence*, although the relation between crop growing and the rearing of animals varies from time to time and from place to place. Bessarabia specializes in the breeding of horses, as is natural on the border of the steppes. The Banat and Bukovina raise quantities of pigs, largely in connection with the growing of maize. All the animal industries date from antiquity, but they received a stimulus from the general era of prosperity enjoyed before the war, for the growth of large towns made an increased supply of meat necessary. Figure 14 shows the actual number of animals in each division and also gives some indication of the loss of draft animals incurred by Old Rumania during the war.

In Old Rumania forests covered less than one-fifth of the land area. Wood, however, has played an important rôle in the domestic life. Absence of wood on the plains was undoubtedly one of the factors delaying settlement there,[14] just as the open prairies failed to attract the early settlers in Illinois.[15] In the new Rumania the proportion of forest is some five per cent greater, the forestal resources of Bukovina (= beechland) and Transylvania, where the forests occupy respectively 43 and 38 per cent of the surface, more than balancing the forestal poverty of Bessarabia.

A passing reference may also be made to the fisheries specially important in the Balta region, that is the 10 to 12 mile wide stretch of river channels, islands, and marshes of the Danube between the heights of Dobruja and the Baragan steppe.

Mineral Wealth

The mineral wealth of Rumania includes petroleum, coal, iron, natural gas, gold, salt, copper, iron, and manganese. Of these petroleum is by far the most important. Rumania's chief claim to present world importance is based upon her oil production (see Fig. 16). Many other countries can produce cereals on a large scale, but to few young states is it given to be fourth in the world production of an important fuel (as Rumania was for several years before the war)—a fuel, moreover, whose total amount is strictly limited and for which the demand is enormous and increasing. The greatest amount in pre-war times came from the Prahova field, of which Ploeshti is the center. The returns for March, 1922, show that the Prahova field still produces over 80 per cent.[16] Along the foothills region there are other fields, but of less importance. Dambovitsa is the center of one to the west of Ploeshti, the Buzău field is to the east of the Prahova, while the Bacău field is in the Moldavian foothills further north. It is probable from the geological structure that there are large deposits as yet untouched.[17] The oil belt of Rumania is continuous with that of Galicia, and promising indications have been obtained in Bukovina, for instance.

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[14] E. de Martonne, article cited in footnote 1, p. 23.

[15] H. H. Barrows: Geography of the Middle Illinois Valley, *Ill. State Geol. Survey Bull. No. 15*, Urbana, 1910, p. 77.

Figure 16 is of further interest here as a comment on the effects of the war. Failure of the petroleum industry to recover its pre-war standing is explained in part by the fact that more than 1500 wells were put out of action before the Rumanian retreat. In addition to this deliberate destruction, the enemy before they departed inflicted great loss on the plant necessary to the oil industry. Reservoirs capable of holding 1,000,000 cubic meters were destroyed, about 1000 wells were burnt out, and refining and pumping plant to the value of 400,000,000 lei (in normal exchange 25.22 lei = £1 sterling) was destroyed. The difficulties of reconstruction in this industry are enormous. All Central Europe from which material and workmen could be drawn has been in the throes of terrible distress. In addition lack of rolling stock and insufficient means of transportation generally (the pipe line to Constantsa has been out of operation) have made it impossible to get that which has been produced to the coast for export. Not only has the amount for export been limited but the amount needed for home consumption has not been forthcoming. This is the more serious as up to now the railways and the manufactures (which are as yet in their infancy) have used oil as fuel. Now it is proposed to substitute coal for the railroads, while the natural gas that is being worked will probably supplement oil in the factories.

Natural gas is found in the basin of Transylvania in the basin of the upper Mures (Maros), east of Turda. It occurs at an average depth of 250 meters and at a pressure which allows the use of pipe lines, of which there are three. In November, 1922, there were already as many as 40 borings.

The calorific value of the natural gas that can be produced each year in Transylvania is greater than that of the coal produced in the whole of Rumania in a year. The cost of securing the gas is one tenth that of securing coal, and its transportation is easier. Engines made for coal fuel can be readily adapted to the use of gas. It seems probable, then, that there may be a change in the manufacturing centers of the country. At any rate here is another powerful ally for industry in Rumania.

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[16] *Correspondence Économique*, Fourth Year, No. 13, June, 1922, Bucharest, p. 24.

[17] L. Mrazec: Compte Rendu Congrès Internatl. du Petrole, 1907.

Old Rumania was lacking in the elements which most favor the development of manufactures, that is coal and iron; but the new boundaries include the coal fields and iron mines of Transylvania and the Banat. The coal fields with the lignite workings in the foothills of Old Rumania give about 4,000,000 tons of coal—not a great quantity but sufficient to reduce in considerable measure the costs of importation. Besides the useful if not extensive deposits of iron ore there are established metallurgical industries in Huniedoara (Transylvania) and Reshitsa-Anina (Banat). In the Bihar is an ancient gold-mining industry with deposits reputed to be the richest in Europe next to those of the Urals. The Transylvanian salt deposits similar to those on the eastern side of the Carpathians double the already excellent resources of the Old Kingdom in this mineral. Mention may also be made of the large deposits of mica discovered in 1918 in the foothills of Wallachia.

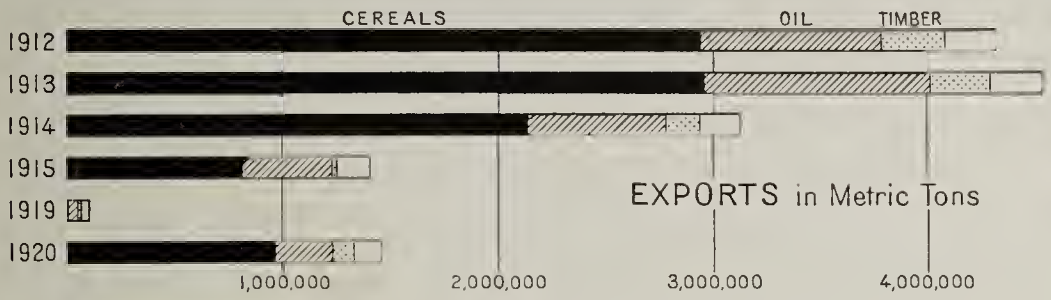

FIG. 16—Diagram showing the annual exports of Rumania by weight.

COMMERCE

From the foregoing it is evident that Rumania is well equipped with the materials that go to build up commerce. The products of the natural regions are sufficiently varied to encourage domestic trade, while certain raw materials are produced in excess and can be exported in exchange for manufactured goods. Analysis of the commercial status of the new Rumania, however, is not easy. The Old Kingdom before the war showed a satisfactory development which we shall first examine.

The most striking feature of the Rumanian export trade is the preponderance of agricultural produce.[18] In 1913 grain formed two-thirds of the total value. During the period 1909–1914 Rumania ranked fifth among the wheat-exporting countries of the world and second in the exportation of maize. Oil is next in importance, at its period of maximum development accounting for one-sixth of the total value. The only other item on the list worth separate mention is lumber, amounting in 1913 to one-eighteenth of the total value.

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[18] See Clive Day: The Pre-War Commerce and the Commercial Approaches of the Balkan Peninsula, *Geogr. Rev.*, Vol. 9, 1920, pp. 277–298. The last really normal commercial year for the Balkan countries and Rumania is 1911—i. e. before the Balkan Wars.

The most striking feature of the import trade is the preponderance of manufactured goods, which in 1913 composed five-sixths of the total value. A hopeful sign for the industrial future of the country is the prominence of metal goods and machinery, which together constituted over one-third of the total. Another important group is that of the textiles, in which cotton yarn and cloth are the outstanding items, the luxury products such as linen and silk being bought in relatively small quantities. There is only a small proportion of food luxuries—sugar, coffee, and tea—and an exceedingly small importation of raw materials. Rumania is still essentially a peasant state, and the peasant needs serviceable clothes and agricultural equipment but has neither taste nor money for foreign food or clothes. Petroleum exploitation explains a good deal of the importation under the classification of metal goods and machinery, which are also required by the mines and the growing industries; but the manufactures for the most part find their raw material in Rumania itself.

Effects of the War on Rumania's Commerce

Figure 16 also shows the beginnings of the post-war recovery. Although there has been a continued gain since 1919, direct and indirect results of the war still render conditions abnormal. War losses are still felt: above all, the loss of draft animals and agricultural equipment, the loss of rolling stock on the railroads, and destruction of the permanent way. As has already been pointed out, land distribution has had the immediate effect of lessening production. The state of exchange has reduced the purchasing power of the country; and, in addition, the acquisition of the new territories has created a currency problem "more easily imagined than described."[19] Old currents of trade have been disturbed by the erection of new frontiers. An instance is given by Professor de Martonne who describes a paradoxical situation in Transylvania, which is "too rich" in some of its resources. Closing of the Hungarian frontier and difficulty of transportation to Old Rumania have brought about such surplus of cattle that they are sold on the spot at very low prices.[20]

The export trade of Rumania has always been subject to fluctuations following the character of the harvest. In 1920 and 1921 Rumania, in common with other countries of eastern and southeastern Europe, suffered from drought; and export of wheat was forbidden by the government. Again, the reduction of petroleum exports is due not only to general conditions in the industry but to increased domestic demands. It is estimated that the addition of territory will call for a total domestic consumption of 70 per cent of production.

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[19] Alexander Adams: Report on Economic Conditions in Roumania, April, 1921, Dept. of Overseas Trade, London, 1921, p. 24.

[20] Emmanuel de Martonne: La Transylvanie, *Bull. Soc. de Géogr. de Lille*, Vol. 64, 1922, pp. 93–102; reference on p. 98.

CURRENTS OF TRADE

Before the war about three-fifths of Rumania's imports came from Austria-Hungary and Germany and about a quarter from the other industrial countries of western Europe (Great Britain, France, Belgium, and Holland). Of the exports only one-eighth went to the former group; two-thirds went to the countries of the latter group, and of them Belgium took more than half, Antwerp acting as an entrepôt for further distribution. Germany and Austria are now far less favorably situated for trade with Rumania. Where Germany formerly held a privileged position she now faces the customs barriers of the new Slav states. Austria has lost her chief industrial districts to one of these states. In this connection note may be made of the importance of the commercial treaties recently concluded by Rumania with Czecho-Slovakia and Poland.

Professor Day in his study of Balkan commerce[21] pointed out that a surprising proportion of trade between Austria-Hungary and Germany and Rumania was carried on by rail (see the accompanying table).

TABLE I—TRADE OF RUMANIA, 1912

	WITH GERMANY			WITH AUSTRIA-HUNGARY		
	Rail	River	Sea	Rail	River	Sea
Exports	5%	5%	90%	87%	5%	8%
Imports	52%	2%	46%	92%	7%	1%

Chaotic conditions of land transport as well as political considerations are likely to cause a diminution in these former trade currents. On the contrary, trade by river and sea is likely to gain. In the Danube Rumania possesses an important commercial artery susceptible of greatly increased utilization. Trade on the Danube has suffered both from political discrimination and physical disabilities.[22] In the past it was hindered by the tariff imposed by Austria-Hungary to encourage the port of Trieste. Improvement of the waterway is needed particularly in the Iron Gates section, a matter in which Rumania is now still more interested because of the extension of her riparian territory. She will seek to divert exports from the Banat downstream from the former course upstream to Budapest.

In Old Rumania traffic on the Danube, which increased steadily downstream from Turnu Severin, was principally in grain. Sixty per cent of the grain was shipped from Sulina at the mouth of the channel regulated by the Danube Commission. Since 1920, however, the tendency has been to ship more grain from Briăla, which like Galatz is not only a shipping town but also a collecting center. Constantsa also shares in the grain trade and is the petroleum port with a special petroleum basin, storage tanks, and pipe lines that formerly crossed the Danube by the Cernavoda bridge. This famous bridge, destroyed during the war and reopened in 1922, also gives Constantsa rail connection with the trunk line running west through Bucharest and north through Buzĕu to Cernowitz. While the Danube ports are usually ice-bound during the winter, Constantsa has the advantage of being open throughout the entire year.

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[21] See footnote 18.

[22] Cf. the note on "The Danube as a Waterway" elsewhere in this number of the *Review*.

The new territories are better equipped with railroads than the old kingdom except in the case of Bessarabia, where particular difficulty has been experienced in grain shipment. The lines here were of different gauge and tended to converge on Odessa but normalization of guage and building of new lines is in progress. Nor has it been possible to take full advantage of the rivers, Pruth and Dniester, which like all the other Rumanian waterways are suffering from lack of equipment lost during the war.

With the rehabilitation of waterways and railroads Rumania's commerce cannot fail to develop. She occupies a geographical position highly favorable for international trade, lying contiguous to the crossroad between western Europe and the Near East and the Russian iands and the Mediterranean.

The Population

In considering the future of Rumania two aspects of the human element call for special mention here, the problem of education and that of the alien population.

While the new Rumania probably includes a somewhat greater proportion of urban population, the vast majority still remains rural. Out of 16 to 17 millions,[23] more than 14 millions are villagers; and of the town dwellers only about half are engaged in manufacturing and mining. When one reflects that the Rumanian peasants are poorly educated and in general ignorant of modern methods of farming and that they have in their hands the greatest asset of the country, the importance of their education is seen to be immense. Another problem in education is presented by the growth of the state in industry and commerce. The present exploitation of oil and other minerals is largely carried on by foreigners—an unsatisfactory condition for national progress. Promise of improvement in this direction, however, is given by the opportunities now offered by the universities (Bucharest, Jassy, Cluj, Cernowitz) and the technical institutes. The proposed budget shows that the Rumanian government is seriously occupied with the problem of national education.[24]

The physical complexity of this country at the meeting point of Balkans, Central Europe, and the Russian plains has had a bearing on the present state of ethnic complexity.[25] Surrounding the solid Rumanian block of the

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[23] The *Bul. Soc. Reg. Române de Geogr.*, Vol. 39, 1920, p. 381, gives the population of Rumania as 16,262,000 distributed thus: Old Kingdom, 7,897,000; Bessarabia, 2,345,000; Bukovina, 812,000; Transylvania, 2,686,000; Crishana, 1,145,000; Maramuresh, 467,000; Banat, 910,000.

[24] Aristide Blank: The Public Finances of Rumania, "*Manchester Guardian Commercial*," *Reconstruction in Europe*, 1922–23, pp. 292–295.

[25] For a study of the ethnic composition of the new Rumania see Emmanuel de Martonne: Essai de carte ethnographique des pays Roumains, *Ann. de Géogr.*, Vol. 29, 1920, pp. 81–98, and also the article of the same author cited in footnote 1.

Old Kingdom is a belt of largely mixed population. Poles, Ruthenians, Little Russians, Tatars, Turks, Greeks, Bulgars, Serbs, Slovaks, Hungarians appear in succession and overlapping as one goes round the circle. The Hungarians known as Szeklers form a solid group in the heart of Transylvania, and Germans are widely distributed throughout the mixed zone; Jews are most numerous in the northern part of the country and in the towns. The alien element amounts to between 20 and 25 per cent of the population of the entire country. From this point of view Rumania has on her hands a more complex minorities problem than any other European state, and her treatment of the matter may be looked upon as a test case of the form of treaty devised for its solution.

THE POPULATION OF POLAND ACCORDING TO THE CENSUS OF 1921

By Eugene Romer
University of Lwów (Lemberg)

The new international boundary lines on the political map of Europe enclose territories for which there were not available proper statistics of population and industry. The parts of which such national units were composed had statistics of different dates taken under quite different conditions and methods. Among all the new political units the case of Poland offers the best illustration of these difficulties.

The first attempt at the reorganization of statistics on a national basis was made during the war by the author of this article in collaboration with a number of Polish scholars and was published as an atlas with descriptive text.[1] The area included was that of "historic" Poland, that is just before the Partition of 1772 when the Polish state occupied 753,000 square kilometers together with certain contiguous territories having a large Polish population.[2] The difficulties in the way of producing such a work may be comprehended if it is recalled that for twenty years there had been no census of the greater part of the country and in the whole of the country the statistics were deliberately altered by the three powers (Russia, Austria, and Germany) that participated in the division of Polish territory. The first and last Russian census was taken in 1897. In 1912 there were three different official figures for the population of Congress Poland—11,913,926; 12,782,347; 13,274,700. For the population of the six so-called Western governments of Russia, comprising the ancient Polish provinces of Lithuania and Ruthenia, there were in 1909 two official figures—22,633,807 and 24,189,000. In the case of some of the smaller units of administration (*powiats*) the official figures varied by as much as 20 per cent, as has been proved by Szulc.[3]

These preliminary remarks are sufficient to indicate the importance of the Polish census of September 30, 1921. It is the purpose of this article to point out some of its significant results. The area comprehended is that of the Polish states as constituted on September 30, 1921, together with the district of Wilno (Vilna)[4] and the parts of Prussian Silesia which were united with Poland after this date,[5] the figures for which have been taken from the Polish census of December, 1919, and the German census of the same year respectively.

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[1] Eugeniusz Romer: Geograficzno-statystyczny atlas Polski (Atlas de la Pologne, géographie et statistique) 32 sheets of maps with 32 sheets of accompanying text, in portfolio. Warsaw and Cracow, 1916. Reviewed by R. H. Lord in the *Geogr. Rev.*, Vol. 11, 1921, pp. 308–309.

[2] See the writer's article "Poland: The Land and the State," *Geogr. Rev.*, Vol. 4, 1917, pp. 6–25.

[3] Stefan Szulc: Appréciation des données statistiques relatives à l'état de la population de l'ancien R. de Pologne. Office Central de Statistique de la République Polonaise, Warsaw, 1902.

[4] It is desirable that the official Polish form "Wilno" should replace the now conventional "Vilna" which came into use during the nineteenth century as a result of Russian influence. Wilno was from the earliest times, even as a capital of ancient Lithuania inhabited by White Russian (Ruthenian) people known as Wilnia, whence the Lithuanian Wilniuja and the Latin Vilna. For centuries the Polish form has been Wilno. It appears thus in two cartographical works of capital importance for Polish toponymy: Joannes Jacobus Kanter: Regni Poloniae . . . Nova Mappa Geographica, 1770 and J. A. B. Zannoni Rizzi: Carte de la Pologne, 1772.

GENERAL RESULTS OF THE CENSUS OF 1921

Table I gives the total population, population density; and number and percentage of Poles in the greater administrative units (*województwo*).

TABLE I—GENERAL RESULTS OF THE CENSUS OF 1921

Administrative Division	Area Square Kilometers	Total Inhabitants	Inhabitants per Sq. Km.	Number of Poles	Percentage
1. City of Warsaw .	121	931,176	—	673,320	72.3
2. Warsaw	29,310	2,112,108	72	1,895,186	89.7
3. Lódź	19,034	2,251,097	118	1,859,488	82.6
4. Kielce	25,736	2,534,214	98	2,312,374	91.2
5. Lublin	31,160	2,085,557	67	1,776,047	85.2
6. Bialystok . . .	32,518	1,302,259	40	996,014	76.5
7. Wilno	14,105	499,499	35	343,335	68.8
8. Nowogródek . .	38,190	1,300,069	34	649,719	50.0
9. Polesie	41,463	876,665	21	190,700	21.8
10. Wolhynia . . .	29,943	1,433,157	48	207,932	14.5
11. Poznań	26,558	1,974,057	75	1,628,522	82.5
12. Pomerania . . .	16,374	939,495	57	754,907	80.4
13. Silesia (Katowice)	3,225	980,296	304	674,000	68.7 †
14. Cracow	17,448	1,990,399	114	1,850,838	93.0
15. Lwów	27,024	2,718,856	101	1,525,751	56.1
16. Stanislawów . .	18,368	1,348,481	73	294,381	21.8
17. Tarnopol . . .	16,240	1,429,627	88	633,948	44.3
18. Silesia (Cieszyn)	1,009	145,232	144	110,756	76.3
Poland	387,826	26,852,244*	69	18,377,218	68.4

* Including military population (318,452) the total is 27,170,696.

† The percentage of Poles in Upper Silesia is according to the German census of 1910.

In respect of area Poland occupies the sixth rank among the European states (after Russia, France, Spain, Germany, and Sweden) and also the sixth in respect of population (after Russia, Germany, England, France, and Italy) but only the twelfth as regards density of population (after Belgium, Holland, England, Germany, Italy, Czechoslovakia, Switzerland, Hungary, Denmark, Austria, and France, which last with a density of 71 inhabitants per square kilometer does not greatly surpass Poland).

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[5] The provisional Polish-Lithuanian boundary drawn up in February by the League of Nations but protested against by Lithuania was confirmed by the Conference of Ambassadors, March 14, 1923. The boundary of eastern Galicia was confirmed at the same time.—EDIT. NOTE.

Density of Population

Considering the size of the Polish provinces, the largest of which has an area equal to that of Switzerland, the contrasts in population density certainly claim attention—a density equal to that of Belgium on the one hand, that of Russia on the other. The greatest densities (more than 100 persons per square kilometer) are concentrated in the southwest, the smallest in the northeast.

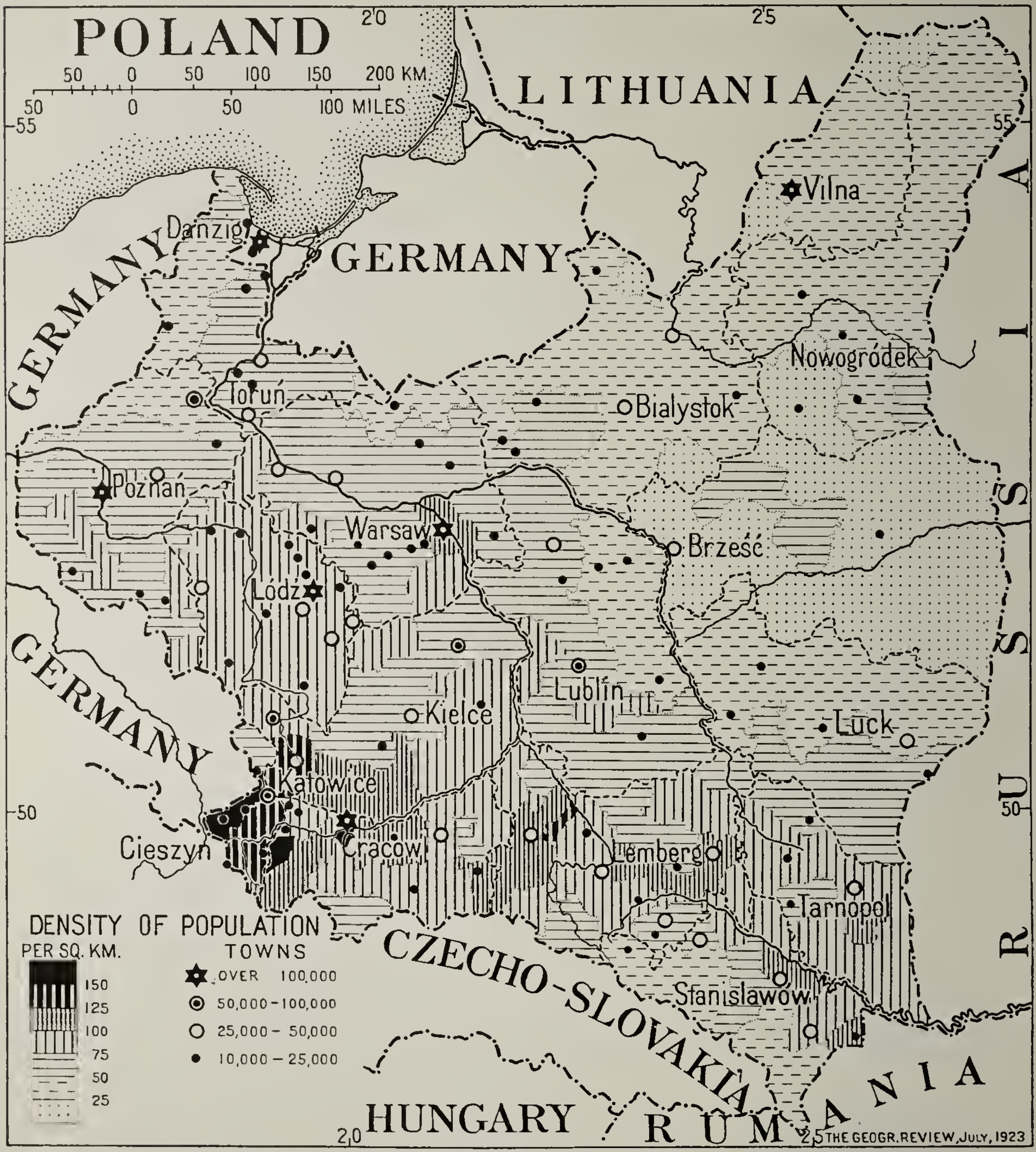

Fig. 1—The distribution of population in Poland according to the census of 1921. Towns of over 10,000 population are shown and the density of population exclusive of these towns. It is impossible to show all the towns in the mining districts of Upper Silesia and its borders. The German Census of 1919 gave 19 places of population of over 10,000 in the area of Upper Silesia awarded to Poland. Scale of map 1: 7,000,000.

The cartogram, Figure 1, shows details of the population distribution in

Poland, towns of over 10,000 population being eliminated. The first striking feature is the increasing concentration as one proceeds from east to west. In the degree that the areal base of national life becomes broader its pulsation weakens, and the density of population decreases; inversely, it increases according as this base, limited by the Baltic and the Carpathians, narrows in the west. This is especially notable in the western Carpathians, a region of no great agricultural development, without any important mining industries, yet more populous than the plains about the capital.

This broad statement of distribution is modified in detail by the operation of other more general factors. The greatest concentration in the west is in response to the geological factor—the coal fields and their related industries; in the east it reflects the distribution of loess and chernoziom (black earth). The sparse population of a rather considerable area in northwestern Pomerania is easily accounted for by the barren glacial and postglacial sands.

The Town Population

The urban population is considered as that dwelling in places of over 10,000 people. The geographical situation of these towns is indicated in Figure 1.

Among the forty towns of more than 25,000 inhabitants, seven are situated on the Vistula, seven in the region of economic contrasts on the border of the Carpathians, six on the coal fields, and five have been created by industry dependent on coal. The other towns are situated at communication centers, at old highroad crossings now railway junctions, often on the greater rivers. Radom (department of Kielce) is the only exception in this category, as it is no railway junction.

There are few towns in Poland. The urban population forms scarcely one-fourth of the whole number, and, if we take into consideration the fact that the population of hundreds of settlements now decayed has been included in this percentage, the proportion will prove to be still smaller. Thus among 642 settlements with municipal by-laws there are only 128 that have more than 10,000 inhabitants, the rest of these so-called towns having an average of 3000.

Table II shows the considerable differences between the number of towns in the eastern and western sections of the country.

Table II—Number of Towns of Given Population in Western and Eastern Poland

Region	10,000–25,000 Inhabitants	25,000–50,000 Inhabitants	50,000–100,000 Inhabitants	More than 100,000 Inhabitants
West	66	24	6	5
East	22	3	1	1

NUMBER AND DISTRIBUTION OF POLES

The census of 1921 registered a long list of cultural classifications—among them creed, mother tongue, and nationality. As to the latter, two categories only have been calculated hitherto: "Poles" and "other nationalities."

Figure 2 illustrates the distribution of Poles—a picture quite different from that given by the official censuses of the occupying powers. The differences between the new ethnographical picture and the old one are only quantitative for the west, both quantitative and qualitative for the east. In the west the percentage of Poles generally surpasses 90; it decreases to 75–50 in the districts on the Noteć, where the former maps showed a German majority. Our diagram shows also that the Polish majority not only reaches the river Bug practically throughout its course (quite otherwise in the old maps) but also forms a large compact peninsula in the northeastern provinces, Bialystok, Wilno, and Nowogródek. Even in the three outermost districts on the Dvina (Braslaw, Dzisna, and Swieciany) the Poles form the most numerous element of the population. The only trait common to the new ethnographical picture and the former ones is the Polish minority in the southeast. But there also considerable areas with a Polish majority are found, as in Wolhynia and Podolia along the rivers Bug-Prypeć and in the surroundings of Lwów and Tarnopol; and a great majority of the more populated districts therein do not count much less than 50 per cent of Poles. Only in the waste fens of Polesie and the interior of the eastern Carpathians are there extensive areas with less than 25 per cent of Poles. In three districts only are there less than 10 per cent of Poles.

TABLE III—PERCENTAGE DISTRIBUTION OF POLES: NUMBER OF DISTRICTS

CENSUS	0–10 PER CENT	10–25 PER CENT	25–50 PER CENT	50–75 PER CENT	75–90 PER CENT	OVER 90 PER CENT
Of the occupying powers . . .	34	16	52	52	74	28
Polish census 1921	3	25	42	43	76	80

The figures in Table III summarize the differences in the ethnographical picture of Poland as given by the administration of the occupying powers before the war and by the 1921 census respectively.

The number of districts with less than 10 per cent of Poles has diminished to one-eleventh; that of the districts with more than 90 per cent of Poles has increased threefold. Furthermore, according to the former censuses all districts with more than 90 per cent of Poles, only two being excepted, were in Galicia, whereas according to the new census there are 56 such districts outside of Galicia. Thus the number of these districts with maximum percentage of Poles increased 28 times as compared with the pre-war figures!

Figure 3 illustrates the geographical distribution of these ethnographical changes. Three well-defined areas may be distinguished. The first comprises the whole territory that belonged to Austria, chiefly its western part where the percentage of Poles has generally decreased. In eastern Galicia, where one would expect this decrease to be strongest, it is in reality the smallest, and considerable tracts even show an increase. In western Galicia, which is Polish to the core and comprised even in pre-war time the greatest number of districts with more than 90 per cent of Poles, this decrease is more formal than real. It is caused by the secession on a large scale of the Jews who hitherto professed Polish nationality, as the Austrian statistics did not recognize the Jews as a race. This fact may in itself be taken as a fair proof of the impartial nature of the last census.

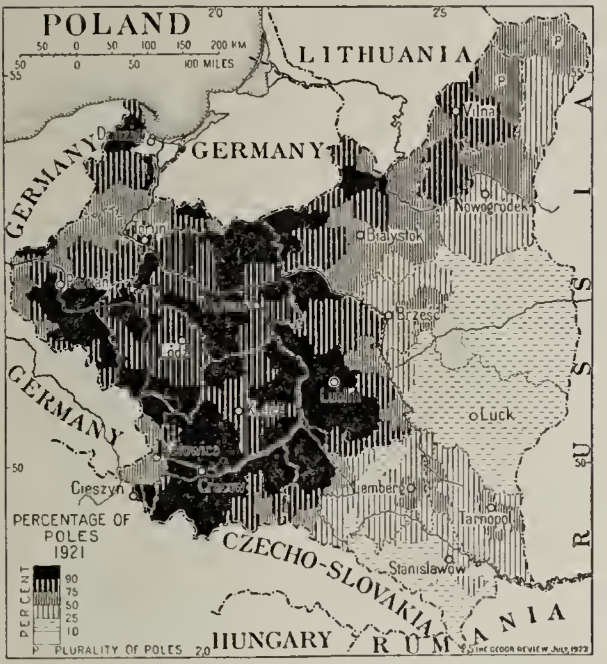

FIG. 2

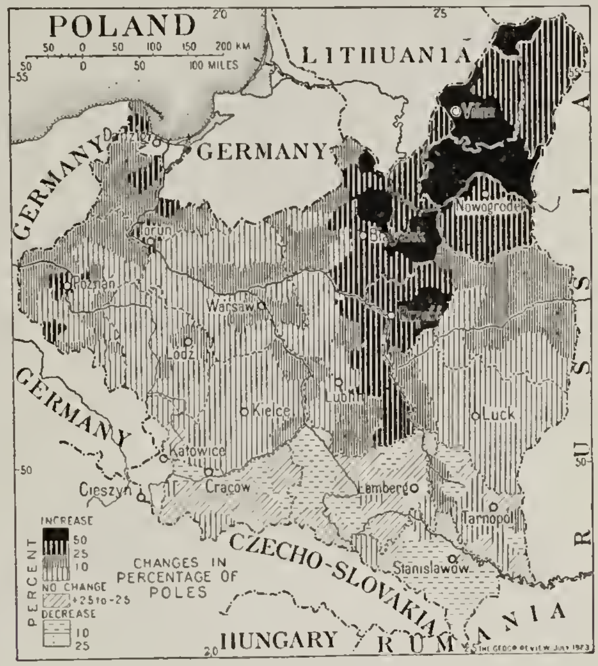

FIG. 3

FIG. 2—Percentage of Poles in the total population of Poland. Scale of map 1:14,500,000.

FIG. 3—Changes in percentage of the Poles in the total population before and after the war—1910 for German and Austrian Poland and 1897 for Russian Poland and 1921 respectively.

The rest of Poland shows a considerable increase of percentage of Polish inhabitants. Nevertheless, two different areas of general increase may be distinguished. One of them comprises the former Prussian provinces and the greater part of former Congress Poland; to the other belongs its eastern part and the whole northeastern section of the country. Wolhynia, however, should be classed with the first group where the increase, though general, nowhere attains an enormous degree; it oscillates between 5 and 25 per cent. A certain abnormal increase may be remarked in Pomerania and in the frontier districts of the province of Poznań.

But it is only in the northeast and all along the river Bug that the last census offers really enormous rates of increase of Polish population. One may in fact speak not of an increase but of a sudden and complete ethnographical change; for a territory which, according to Russian statistics, was *not* Polish, proves now to be *only* Polish. This fact was stated in 1916 and 1918[6] by the German authorities in occupation, by whom, however, it was carefully hushed up; and afterwards by the Polish administration in December, 1919.[7] Yet it can hardly be described as a surprising revelation, for it had been foreseen by impartial foreign scholars.[8]

The Changes of the Population Caused by the War

Though many differences between the former ethnographical picture of Poland and the recent one may be ascribed to such falsifications, others must be explained by movements and transformations of population caused by the Great War. Their dimensions can be calculated for the former Austrian and Prussian territories by comparing conditions of 1921 with those of 1910.

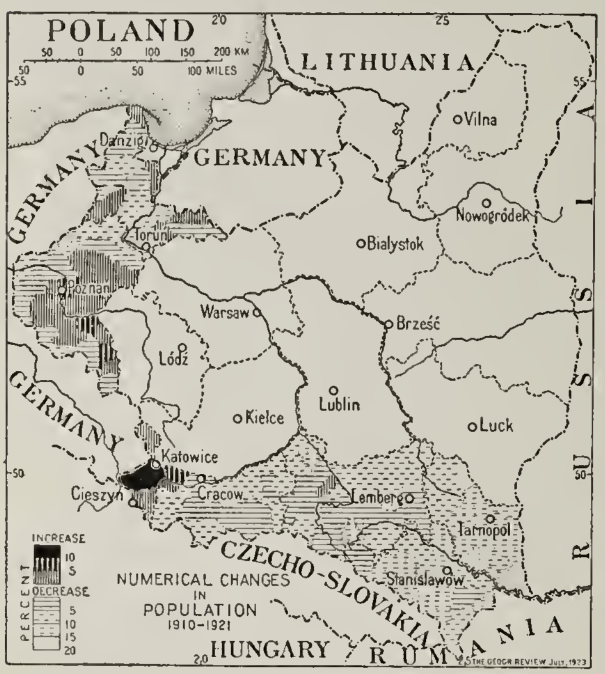

Fig. 4

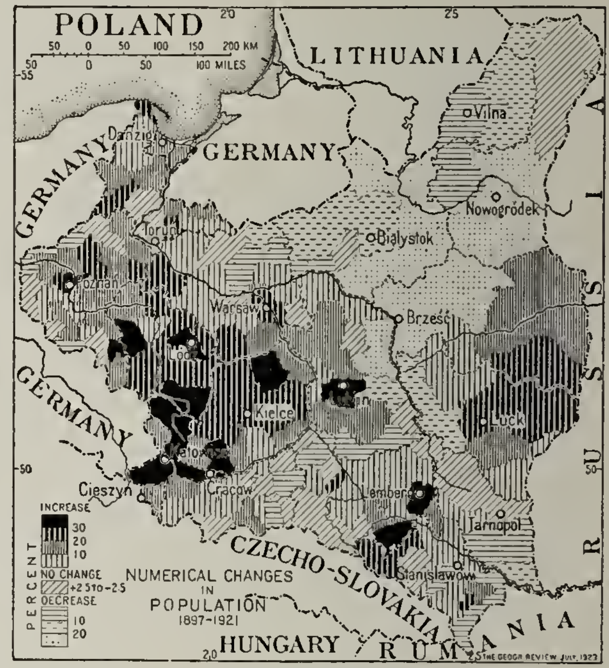

Fig. 5

Fig. 4—Numerical changes in total population of former German and Austrian Poland (Poznân, Pomerania, Silesia, Galicia) before and after the war—1910 and 1921 respectively. Scale of map 1:14,500,000.

Fig. 5—Numerical changes in total population of Poland during the last twenty-five years.

Figure 4 illustrates these conditions. The movement of population in former Galicia and the adjacent part of Silesia proves that the whole area has suffered considerable devastation. Only the coal fields and the industrial districts near Cracow show a greater or smaller increase of population during the period 1910–1921; but farther to the east, where the fighting was fiercer and longer sustained, the decrease becomes still more considerable. It is also clearly apparent that the mountains, affording a natural shelter, have been less depopulated than the plains of the north. Before the war parts of this area showed marked natural increase, and in cases where decrease was registered it was explained by excess of emigration over natural increase.[9] It may then be calculated that a great number of districts in eastern and southeastern Galicia must have lost about 30 per cent of their population through the devastations of war. There are many indications that the losses inflicted by the war have weighed more heavily on the Ruthenian population (or "Ukrainian" as they have called themselves for some time) than on the Polish element, which defended itself vigorously against the evacuations organized in Galicia and Congress Poland by the retreating Russian armies.

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[6] The Eastern Border of Poland, Paris, 1919. Polish Comm. of Works Preparatory to the Peace Conference.

[7] Eugene Romer: Statistics of Languages of the Provinces Being Under Polish "Civil Administration of the Eastern Lands" (December, 1919), *Geographical Works, Memoir No. 7.* Lwów and Warsaw, 1920. (In Polish, French, and English.)

[8] "There is much reason to suppose that if ever an honest census is taken here, the eastern limits of the Polish ethnographic area will be extended considerably beyond the boundaries of the Congress Kingdom" (C. H. Haskins and R. H. Lord: Some Problems of the Peace Conference, Cambridge, Mass., 1920, p. 159).

Figure 4 is still more illuminating as regards the movements of population between 1910 and 1921 in the former Prussian provinces. It appears that the Polish center of this territory, where the officially directed German colonization had not yet penetrated to any great extent, not only suffered no decrease but even shows a distinct increase of population for that period. The fact that all districts situated on the German frontier and nearly all Pomerania, especially the territory on the Noteć, colonized by the Germans systematically and intensively since the time of Frederick II, have suffered general and severe losses, throws a light on the cause of these contrasts. The German settlers, owing all their welfare to the state and brought up in obedience to it, spontaneously made far greater sacrifices than the Poles who succeeded in avoiding the burdens imposed by the war. This circumstance, together with the remigration of German colonists and the influx of Poles from other sections of the country, explains the shiftings of population in the former Prussian provinces during the war and at the same time the considerable increase of the Polish element inhabiting them.

Besides the actual loss of German population a factor of entirely different order has influenced the comparative increase of Polish population. The researches of Andrzejewski,[10] published on the eve of the signing of the peace treaties, showed that from 25 to 35 per cent of the German inhabitants of Prussian Poland were dependent on the state, as colonists and officials. According to his calculations more than 50 per cent of the German population of 17 districts and 75 per cent of that of four other districts were more or less materially dependent on the Prussian government. It is quite natural that this class should participate most largely in the remigration to Germany. Yet on further consideration it appears that the remigration from the provinces of Poznań and Pomerania does not agree with the statements of Andrzejewski. It is easily conceivable that among the German population counted previously by the Prussian census there had been a great number of Poles who only adhered to their nationality in the census of 1921. Before the war often only school children dared to do so, hence the difference between the results of official Prussian censuses and those of official statistics of the mother tongue of school children.

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[9] Romer, Atlas de la Pologne, 1916, Pl. VIII; 2nd edit., 1921, Pl. IX.

[10] Liber (Andrzejewski): Das Deutschtum in Westpolen, Poznań, 1919; E. Romer: Population allemande en dépendance du gouvernement prussien, Paris, 1919; Isaiah Bowman: The New World, New York, 1921, p. 338.

In default of a Russian census corresponding to those for Germany and Austria it is impossible to evaluate the corresponding losses and shiftings of population caused by the war in former Russian Poland. However, the wish to solve at least in some measure the interesting problem of the war losses in this section of the country led me to an approximate calculation based on an interpolation between the Russian census of 1897 (the sole basis for demographic research) and the Polish one of 1921, arrived at by comparison with the Austrian and Prussian censuses of 1900, 1905, and 1910.

Numerical Changes of Population During the Last 25 Years

The calculated movement of population in the last 25 years is shown in Figure 5. The results are really unexpected. In this picture there is only one zone of devastation, a broad belt beginning in the northeast, comprising the whole province of Bialystok, a part of the provinces Wilno and Nowogródek, and growing narrower towards south-southeast, across the eastern part of the province of Lublin and the west of the provinces of Polesie and Wolhynia. The traces of this zone of devastation are visible in the extreme east of former eastern Galicia (provinces of Tarnopol and Stanislawów). The whole zone, which is generally speaking identical with that of long-lasting combats, frequent strategic shiftings, and the evacuations connected with them, shows a really dreadful depopulation. Full particulars will be known only after the publication of the detailed results of the census for the different localities; but it can be stated now that this zone, the poorest of Poland as regards natural resources and degree of civilization, has suffered most cruelly from the devastations of the war.

Depopulation in Poland and in France Compared

The facts are as follows: the area of German invasion in France comprised the *départements* Aisne, Ardennes, Marne, Meurthe et Moselle, Meuse, Nord, Pas de Calais, Somme, Vosges.[11] This area of 57,112 square kilometers counted 6,112,000 inhabitants in 1911 and only 5,392,000 in 1921, a loss amounting to 720,000 persons, i.e. 11.7 per cent of the population of 1911.

The area of devastation in Poland is much greater. If we set aside the provinces of Wilno and Nowogródek because of difficulties of comparison on account of the changed system of administration, there remain 52,457 square kilometers in the provinces of Bialystok, Lublin, Polesie, and Wolhynia where the number of inhabitants was 2,479,900 in 1897 as against 1,905,200 in 1921, i.e. the population loss with relation to 1897 amounts to 23 per cent. Considering that the natural increase of this population was at least one and a half per cent per annum, or 26 per cent at the outbreak of war and 37 per cent up to the year 1921, it is quite certain that since 1914 at least 39 per cent of inhabitants of this territory have disappeared, or 43 per cent if one allows for loss of natural increase during the war. Similar calculations concerning the center of this area of devastation, that is the districts of Bialowieza, Bielsk, Brześć, Drohiczyn, Kobryń, and Pruzana, show that the 1921 population is scarcely one-half of that of 1914.

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[11] Maurice Zimmermann: La population de la France en 1921, *Ann. de Géogr.*, Vol. 31, 1922, pp. 37–51; reference on p. 39.

Fortunately, a considerable part of these losses may probably be ascribed to the evacuations which were organized on a large scale at every retreat, especially during the first defeats of the Russian armies. In the Russian chaos beginning soon afterwards the fate of the homeless masses was of course little better than death.

Without taking into account the systematic falsifications committed by the Russian administration in 1897, one must not overlook the fact that the depopulation of the above-mentioned zone was largely among Ruthenians and White Russians, that is the population of Orthodox faith, and therefore greatly contributed to the reinforcement of the Polish and Catholic element of this territory.

On Vast Territories No Marked Traces of War

Outside the zone discussed above there is another result of this demographic analysis that also, in some measure, is unexpected. Not only to the west of the zone of great devastations but also eastward, especially in the fen country of Polesie and in the northern part of Wolhynia, the ravages of war did not destroy the considerable natural increment of the population.

Similar conditions obtain to the west; above all, in the western part of the province of Lublin and in the part of the former Congress Kingdom which is situated westward of the Vistula, where the war seems to have left no traces at all in the population movement. A comparison with a map of annual increase of population in pre-war Poland[12] with Figure 5 shows that westward of the zone of great devastations the war did not alter the regional peculiarities of the population. The territories of pre-war emigration appear also in the new picture as areas of decrease, and those of pre-war immigration as areas of increase. In short, the Great War caused only quantitative modifications of these movements westward of the rivers Bug and Narew, but it did not alter them essentially, that is, qualitatively.

Causes of the Increased Percentage of Poles

The reality of the extraordinary ethnographic changes in the eastern and western border territories appears to be sufficiently well explained by the causes given above—in the east, falsifications of the official pre-war census and shiftings on a large scale of the population; in the west, the same causes together with the fact that Polish officials, remaining in the service of the state, might openly adhere to their nationality.

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[12] Romer, Atlas de la Pologne, 1916, Pl. VIII; 2nd edit., 1921, Pl. IX.

The increase of the percentage of Poles in the territory of former Congress Poland is easily accounted for by the same processes and causes advanced for the provinces of Poznań and Pomerania. It is, however, remarkable that a considerable part of this increase is due to the Jewish inhabitants professing themselves Poles. On the other hand, there are signs that the percentages of the Jewish population stated by the census of 1897 are much greater than the real ones. The above-mentioned researches of Szulc[13] prove that the number of inhabitants calculated by the Russian administration was always higher than the real one and that this surplus increased with every new calculation, as the unsettled inhabitants (for the most part Jews) were often counted twice by the incompetent officials. Hence the conclusion that the number and percentage of the Jewish population is the most uncertain and exaggerated figure of the official Russian statistics.

THE POLES IN GALICIA

We have already mentioned that former Galicia is the only area in Poland where the percentage of Poles underwent a more or less general decrease and have explained it for certain sections by the fact that the Jews could now declare their nationality. Yet a survey of the ethnographic changes in former Galicia, especially in its eastern part, is too important to be passed over without further discussion. Some light is thrown on the question by the school census of December 1, 1921, taken in the whole of Poland. It has been published hitherto only for the province of Poznań. Besides the figures for this province there are at my disposal materials for all the provinces of former Galicia (Cracow, Lwów, Stanislawów, Tarnopol).

During the whole period of peace negotiations in Paris the Polish delegation energetically contested the results of the censuses taken by the occupying powers. As regards former Prussian Poland, the official Prussian census of population was contrasted with the Prussian school census, the results of which were considered less falsified. We are now able to furnish the proof that this assertion of the Polish delegation was correct and that the school census, if based consistently on a compulsory school attendance can replace in some measure the census of population. At the same time we are furnished with proof of the objective character of the Polish census and school census.

Let us consider the figures. According to the Prussian census of 1910 the percentage of Polish population in the former regency of Poznań was only 61, whereas the Prussian school census of 1911 stated that 77 per cent of the school children were Polish. In contrast with this difference in the figures, the Polish census of 1921 indicated 82.5 per cent for the whole of the Polish population in the province of Poznań and 82.1 per cent for the Polish school children there.

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[13] Szulc, *loc. cit.*, p. 31. See also W. Wakar: Rozwój terytorjalny narodowosci polskiej (The Territorial Development of the Polish Nationality), Warsaw, 1907, Vol. 1, pp. 80–91.

These numbers invite a closer analysis of the school census taken in the Galician provinces. It must be remarked, however, that this school census was restricted to the registration of creed, although the regulations had prescribed statistics both of creed and of nationality. The schoolmasters, to whom the school census had been entrusted, evidently identified nationality with creed, namely Jewish, Ruthenian, and Polish nationality with Hebrew, Greek Catholic, and Roman Catholic faith respectively. Only sporadically did they take account of Roman Catholic Germans. A careful examination of the lists gives the impression that no notice was taken of an adherence to Polish nationality if it was not accompanied by Roman Catholic or Protestant faith.

Table IV gives a comparative view of the results of the census of population and the school census.

Table IV—Nationality and Creed in Galicia*
(Percentage)

Province	Poles		Roman Catholics		Hebrews	
	1910	1921	1910	1921	1910	1921
Cracow	95.9	93.0	89.0	91.1	7.8	6.4
Lwów	60.2	56.1	45.2	50.1	12.3	10.4
Stanislawów . . .	25.3	21.8	13.3	21.1	12.2	11.6
Tarnopol	41.0	44.0	28.7	34.0	11.7	11.0

* Figures for 1921 for Roman Catholics and Jews are from the school census.

The table shows a distinct decrease of the percentage of Poles in the whole of former Galicia except in the province of Tarnopol, situated in the extreme east. It is not difficult to find the cause of the high percentage of Poles in 1910. It is approximately equal to the sum of the percentage of Roman Catholics and that of Hebrews. The middle columns (Roman Catholics) show that the essential part of the Polish nationality in former Galicia not only did not weaken in 1921 but, on the contrary, increased rather strongly.

Table V—Change in Percentage of Roman Catholics 1910–1921 According to the Census of Population and the School Census *(By Number of Districts)*

Province	Decrease		Increase			More than 10
	5–2.5	2.5–0	0–2.5	2.5–5	5–10	
Cracow	1	6	7	6	3	–
Lwów	–	1	12	10	4	1
Stanislawów . . .	–	1	1	6	6	2
Tarnopol	–	–	3	3	6	4
Former Galicia .	1	8	23	25	19	7

The number and distribution of districts showing an increase of Roman Catholic population are an incontestable argument that these ethnic changes have been the result of movements of population caused by war and evacuations.

Economic Importance of the Polish Census

The census of 1921 was a bold enterprise and a notable contribution to national civilization. This assertion will not seem exaggerated if we consider that an administration just beginning to function and meeting extraordinary difficulties undertook not only the census of the inhabitants with a complete demographic analysis but also that of domestic animals and agriculture. The drawback of this great enterprise is that several years must elapse before the detailed results will be known, and doubts have been expressed as to whether the Polish administration was equal to a task of such magnitude. At least a partial reassurance may be found in an examination of the provisional results of the census of domestic animals which have been already published.

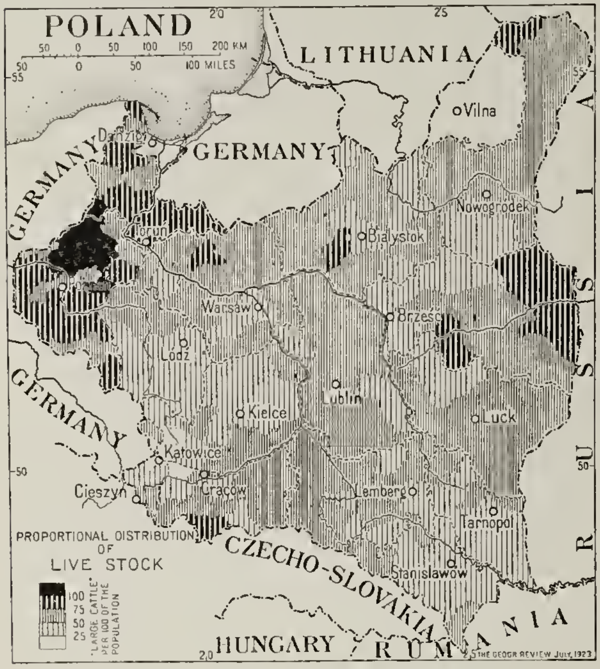

Fig. 6

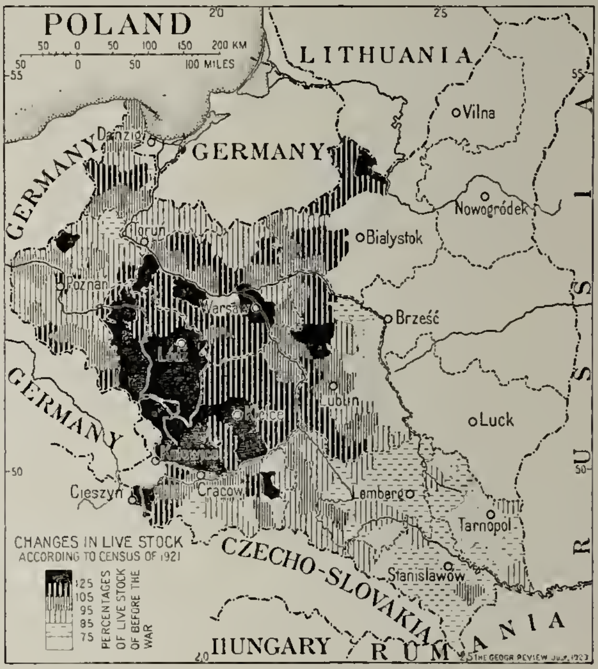

Fig. 7

Fig. 6—Number of head of live stock ("large cattle," see text for explanation of unit) in Poland per 100 inhabitants. Scale of map 1:14,500,000.

Fig. 7—Changes in number of live stock before and after the war.

For the whole of the former Russian territory, Congress Poland included, the Polish census of domestic animals is the first of its kind. The Russian statistics were based upon estimates made by the Ministry of the Interior and the Ministry of Agriculture. Their estimates differed for some governments as much as 75 per cent and on the average 25 per cent. They were limited to governments for the whole of Russia, except Congress Poland.[14]

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[14] Romer, Atlas de la Pologne, 1916, Pls. XXV–XXVII; 2nd edit., 1921, Pls. XXVII–XXIX.

TABLE VI—DOMESTIC ANIMALS IN POLAND ACCORDING TO THE CENSUS OF 1921

PROVINCE	HORSES	HORNED CATTLE	SHEEP	SWINE	"LARGE CATTLE"
Former Congress Kingdom .	1,306,845	3,021,319	725,277	1,816,299	4,963,583
Frontier Territories in the East	619,411	1,257,771	542,370	964,999	2,254,024
Poznań, Pomerania	418,190	1,265,363	621,795	1,396,383	2,188,097
Former Galicia	850,969	2,309,989	281,054	946,437	3,467,833
Poland (without Wilno and Silesia)	3,195,415	7,854,442	2,170,496	5,124,218	12,873,537

To give the results of the census of domestic animals in a short and comprehensive form, I have calculated the number of "large cattle" by counting horses and horned cattle as units and sheep, swine, and goats as quarters of a unit. In this way the sum of domestic animals is expressed without any reference to their species. Figure 6 gives a picture of the number of domestic animals reduced to these units and expressed in per cent of the number of inhabitants for each district. There are no data for the Polish part of Prussian Silesia and for the province of Wilno. The detailed figures are as in Table VI.

TABLE VII—DOMESTIC ANIMALS PER 100 INHABITANTS IN POLISH PROVINCES BEFORE AND AFTER THE WAR

(*Figures before the war in roman type, after the war in bold-face type*)

PROVINCE	HORSES	HORNED CATTLE	SHEEP	SWINE	"LARGE CATTLE"
Former Congress Kingdom	8.8 **11.6**	15.0 **26.9**	6.7 **6.5**	3.9 **16.2**	26.4 **44.2**
Frontier Territories in the East	15.4 **17.1**	32.5 **34.8**	22.5 **15.0**	17.2 **26.7**	57.9 **62.4**
Poznań, Pomerania	14.8 **14.4**	42.5 **43.5**	23.5 **21.4**	53.0 **47.9**	76.4 **75.2**
Former Galicia	11.2 **11.2**	30.6 **30.6**	4.6 **3.8**	22.2 **12.5**	48.1 **45.8**

Setting aside the provinces of Poznań and Pomerania, which are particularly rich in live stock, the rest of Polish territory shows a uniformity of distribution of domestic animals that has been hitherto unrealized. Furthermore, the contrasts between the extreme west and the rest of Poland are incomparably less pronounced than we thought them to be.[15]

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[15] Romer, Atlas de la Pologne, 1916, Pls. XXV–XXVII; 2nd edit., Pls. XXVII–XXIX. See also V. C. Finch and O. E. Baker: Geography of the World's Agriculture, U. S. Dept. of Agric., Washington, D. C., 1917, Figs. 165, 177, 179, and especially 191.

The numbers of domestic animals, before and after the war, expressed in per cent of the population of the different Polish provinces, are as in Table VII. The upper row of figures for each province is according to prewar official statistics, the lower row (in bold-faced type) is according to the census of 1921. The differences expressed as percentage are shown in Figure 7.

Considering the table one cannot do otherwise than draw the conclusion that all pre-war figures concerning Congress Poland and the eastern Polish territories, that is the former Russian provinces, have been completely valueless. For is it possible that in the former Congress Kingdom the stock of horses and horned cattle has increased *during the war* by 30–50 per cent compared with the pre-war stock? And that it increased considerably, if less rapidly, in the east, which has been so terribly devastated by the war?

For great areas which were under Russian administration the Polish census of 1921 unquestionably gives the first correct statistics of the economic life of the country as well as of its demography.

FLOOD AND EBB IN NEW YORK HARBOR

By H. A. Marmer

U. S. Coast and Geodetic Survey, Department of Commerce

The great ports of the world, almost without exception, are situated on tidal waters. Some of these ports are many miles from the sea—London 50 miles from the mouth of the Thames, Hamburg 75 miles up the Elbe—and to reach them the ship-borne traffic of foreign and domestic commerce must traverse the tidal waters that connect these ports with the open ocean. These tidal waters thus serve as highways to the seven seas, and for each port the tidal régime in the channel that connects it with the open ocean is a matter of considerable importance.

In the days of the shallow-draft ship the highway leading from the sea did not possess the importance attaching to it today. Cologne, 210 miles up the Rhine, was in medieval times one of the great Hanseatic seaports, although the channel at that time was less than six feet in depth.[1] But the introduction of steam as the propelling power and the advent of the iron and steel ship, together with the enormous increase in world-wide trade brought about by the industrial development of the past century, make the channel leading to the sea a feature of first importance in the modern harbor.

The time required for a sailing vessel to cross the ocean, together with its dependence on wind and weather, made impossible the maintenance of an exact schedule for arrival and departure. If the channel leading to the harbor was not sufficiently deep to permit entrance at low water the delay of six hours awaiting high water was not a serious matter, for this delay represented but a very small fraction of the time of the voyage. Now with the time of crossing the ocean counted in days and with a transatlantic liner representing an initial investment of several million dollars, a delay of as much as a quarter of a day at each end may mean the difference between profit and loss. For the profit from the modern leviathan—costly in build and costly in operation as a unit—depends on the number of trips it can make a year.

The advent of the iron and steel steamer removed the limitation on the size of ships that wood construction had imposed. The larger ship is also the more profitable one to operate, provided the traffic is sufficiently large. And, where the stream of traffic was sufficient, as in the transatlantic trade, the shipping industry responded with larger and larger vessels. The White Star liner *Majestic*, the largest passenger ship, may be taken as type. Having a length of nearly 1000 feet, a width of 100 feet, and a gross tonnage of 56,000 tons she carries a crew numbering almost 1100 and requires a channel depth of not less than 40 feet. As she steams for the harbor of New York at her normal speed of 575 miles per day the *Majestic* is a far cry from the *Half Moon* of 80 tons' burden and draft of 7 feet, which with a crew of 18 or 20 men Henry Hudson sailed into the same harbor but a little over three centuries ago.

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[1] E. J. Clapp: The Port of Hamburg, New Haven, 1911, p. 30.

To permit the deep-draught vessels of modern commerce to enter port enormous sums have been expended in the effort to maintain a sufficient depth in the channels connecting the seaports of the world with the open ocean. The ideal channel is one sufficiently deep to permit all vessels to enter port at any stage of the tide. Where this ideal was impracticable of realization it has frequently been found necessary to construct a sub-port or twin port closer to sea somewhere along the channel. Obviously this entails extra expense in bringing up the ship-borne traffic, either by rail or by lighter, from the lower sub-port. Despite this, examples of twin ports are not uncommon in Europe. To mention but the more prominent ones we may cite London and Tillbury, Hamburg and Cuxhaven, Bremen and Bremerhaven.

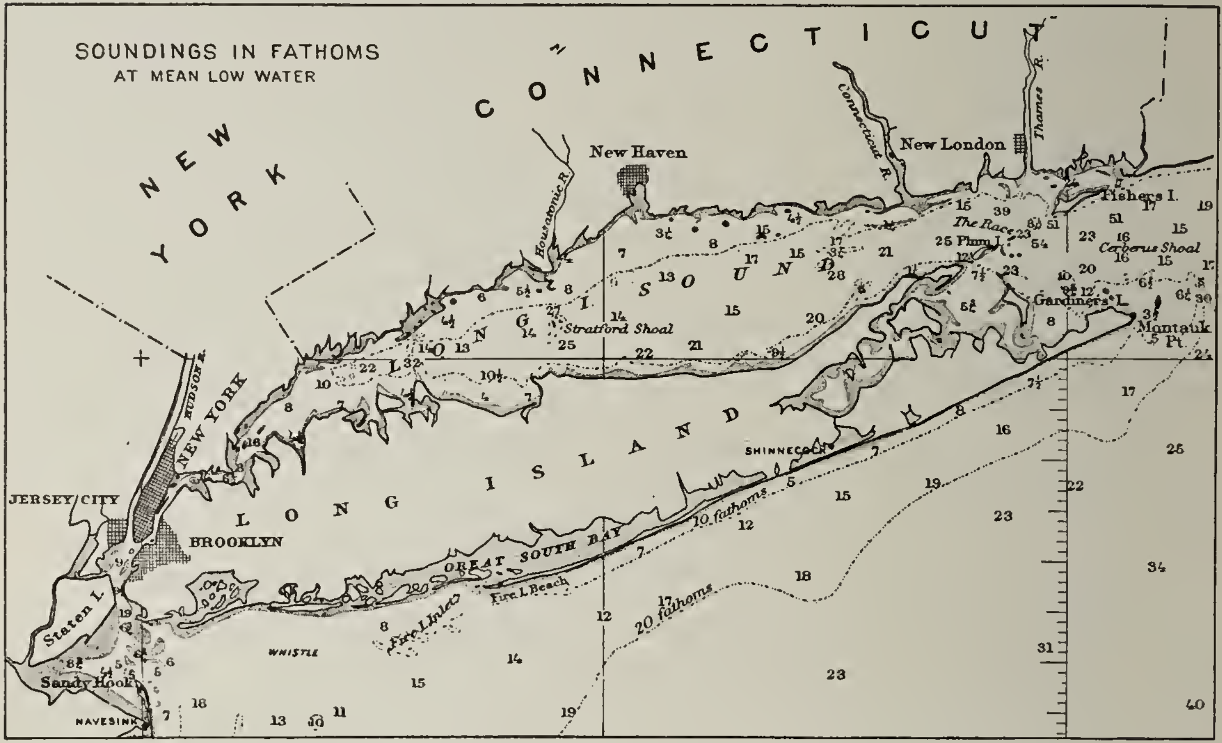

FIG. 1—New York Harbor, showing the two ocean entrances. Reduced from *U. S. Coast and Geodetic Survey Chart No. 1000.*

The tide is the bond that keeps the channel leading to the port in intimate contact with the open sea and its vivifying influences. And the extent of rise and fall of tide in the channel is the factor that frequently determines the type of harbor that must be developed. If the rise and fall of the tide, or more precisely the range of the tide, is over fifteen feet the closed-dock type of harbor generally results. This is exemplified by London with a tidal range of 16 to 21 feet and by Liverpool with a range of 15 to 27 feet.

A large vessel rising and falling with the tide fifteen feet or more twice each day presents a number of problems in loading and unloading. Furthermore, the erection of suitable wharf structures would entail considerable expense. The result in such cases is therefore the closed-dock harbor in which the docks are entered through locks open for a few hours about the time of high water.

Where the rise and fall of the tide is less than fifteen feet and the channel is sufficiently deep the open-basin type of harbor results. In this case piers may be constructed directly into the channel, and a vessel may dock at all stages of the tide, obviating the delay arising in the closed-dock harbor which can be entered or left only near the time of high water. In this regard all the great American ports are fortunately situated, the range of the tide generally being less than ten feet.

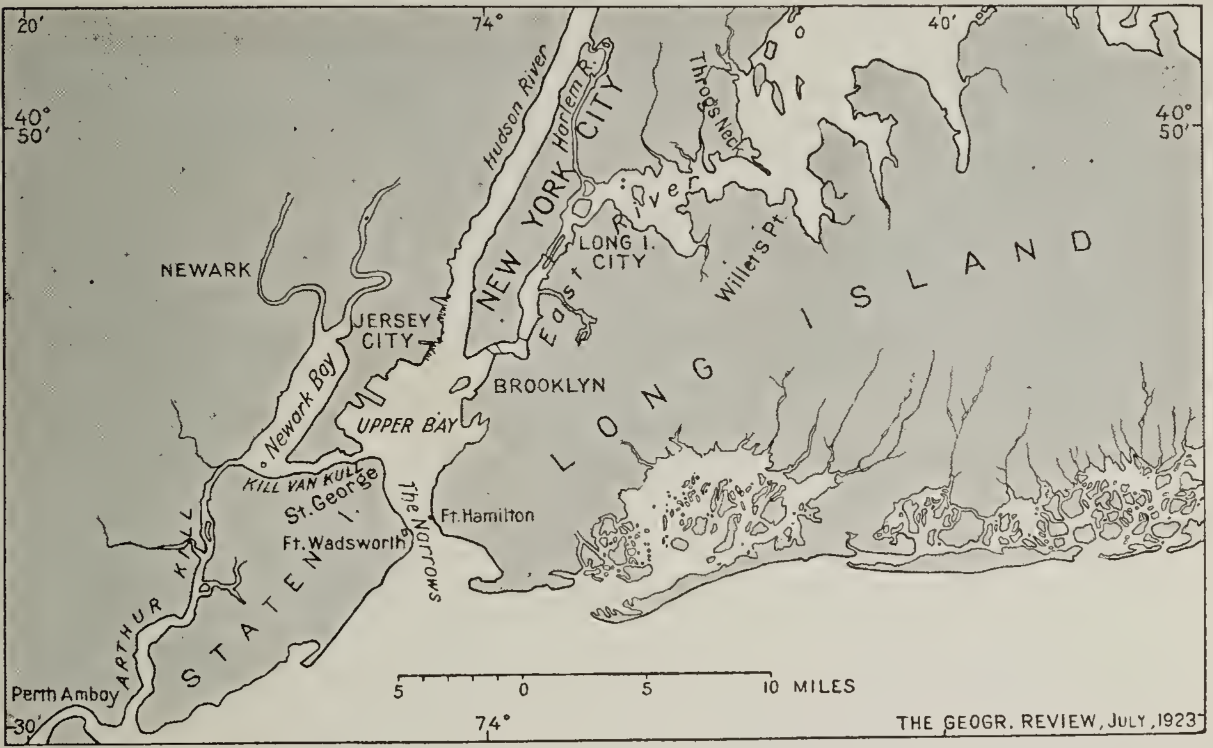

FIG. 2—New York Harbor, showing the relations of the component parts, Upper Bay Kill van Kull, East River, Harlem River, and Hudson River.

THE HARBOR OF NEW YORK

Unlike other harbors which generally consist of a tidal bay or river, New York Harbor comprises a system of five tidal highways that connect with the sea by means of two inlets many miles apart. Figure 1 shows the position of New York Harbor with regard to the ocean, and Figure 2, on a larger scale, shows the relations of the various parts of the harbor to each other. The principal entrance to the harbor is the southerly one past the Narrows, which is the gateway of important trade routes. Through the Narrows come the ships from all the ocean highways, and through this same funnel the exports of a great hinterland, reaching back of the Alleghanies, find their way into the channels of international trade. Past this gateway the largest ships afloat may steam into the harbor at any stage of the tide.

The Narrows leads into Upper Bay, a sheet of water having an area of about 20 square miles; and from this bay three tidal highways radiate. Toward the west Kill van Kull, a short strait, connects with Newark Bay; toward the east East River, a strait about 15 miles long, leads to Long Island Sound, the eastern entrance from the ocean to New York Harbor; and into the northern end flow the waters of the Hudson, a tidal river that drains a territory of some 13,000 square miles. Harlem River, the fifth of the waterways, is a strait about 7 miles long connecting East River with the Hudson. New York Harbor may therefore be taken as consisting of Upper Bay, Kill van Kull, East River, Harlem River, and Hudson River from its mouth to Spuyten Duyvil where it meets the Harlem.

It is obvious that a case may be made out for including, as parts of New York Harbor, Newark Bay and Arthur Kill on the west, Lower Bay on the south, and even Long Island Sound on the east. However, the five waterways enumerated above constitute New York Harbor as usually understood and for the purposes of this paper will be taken to comprise the harbor. This procedure may be justified, too, by the fact that an understanding of the tidal phenomena in New York Harbor, in the more restricted sense used here, may be arrived at without the need of discussing in detail the tidal régime in Newark Bay, Arthur Kill, Lower Bay, or Long Island Sound.

A glance at Figure 1 shows that the tide from the Atlantic Ocean reaches the harbor of New York from two directions. From the east the ocean tide enters East River after traversing Long Island Sound, while from the south the tide sweeps into the Narrows past Sandy Hook and Lower Bay. There is, to be sure, another channel for the tide, namely, from Lower Bay through Arthur Kill into Newark Bay and thence through Kill van Kull into Upper Bay. But the Narrows affords a much shorter and a very much more commodious channel, so that relatively very little of the ocean tide finds its way into the harbor by way of Arthur Kill. The tidal gateways to New York Harbor may therefore be said to be located at Throgs Neck on the East and at Fort Wadsworth on the south.

Into New York Harbor, therefore, the ocean tide finds its way through two inlets many miles apart. This in itself makes possible some variety in the tidal phenomena of the harbor; but still further variety is brought about by the fact that the five component parts which constitute the harbor are either intercommunicating or lead into other waters, so that the tide in one part may be affected by the tide in another.

Tides and Tidal Currents

The response of the ocean to the tide-producing forces of sun and moon is of a two-fold character—there is a vertical rise and fall of the water, and there is also a horizontal movement forward and backward. To distinguish between the two movements the vertical rise and fall is called the "tide," and the horizontal forward and backward movement is called the "tidal current." For convenience the two movements of the water taken together are commonly called the "tide" or "flood and ebb."

In navigation the vertical rise and fall of the tide is a matter of prime importance in the immediate vicinity of the coast or in areas of shoal water. Out in the open sea, however, the vertical rise and fall may be totally disregarded by the navigator, but the horizontal movement of the water is still a matter of practical importance. Furthermore, out in the open the rise and fall of the tide is no longer obvious. Hence, when the mariner speaks of the "tide" he frequently has in mind the tidal current, as when he says "the tide is ebbing."

It is essential, however, to distinguish clearly between tide and tidal current, for the relation between the two is not a simple one nor is it everywhere the same. At one place we may find a strong current accompanying a tide having a very moderate rise and fall, while at another place a like rise and fall of the tide may be accompanied by a very weak current. Furthermore, the time relations between current and tide at different places are subject to wide variation. To avoid confusion, therefore, it is advisable to use "tide" in reference to the vertical movement of the water and "current" in reference to the horizontal movement.

In connection with the phenomena of the tides the terms "rise," "fall," "flood," and "ebb" are of frequent occurrence. The first two clearly pertain to the vertical movement of the water, and no confusion arises from their use. Flood and ebb, unfortunately, are made to refer indiscriminately either to the vertical movement or to the horizontal movement and, furthermore, to the general phenomena of the tides. In the latter use, to be sure, there is no danger of confusion, since the context indicates the meaning; but in such phrases as "the tide is ebbing" it is not at all clear whether a falling tide or an ebb current is meant. And it is to be noted that a rising tide does not necessarily imply an inward-flowing current, nor is a falling tide synonymous with an ebbing current. For the sake of clearness, flood should refer to the horizontal movement of the water toward the land or upstream, and ebb to the horizontal movement away from the land or downstream.

The Tide at the Southern Gateway

The tides in the Narrows, the southern gateway to New York Harbor, are quite well determined. For more than a quarter of a century an automatic tide gauge has been in operation at Fort Hamilton, furnishing a continuous record of the rise and fall of the water night and day, winter and summer. In its larger features, the tide in the Narrows is of a relatively uniform character from day to day; but a close examination shows certain variable characteristics. The varying positions of sun and moon in the heavens, the changing winds, unusual rainfall, freshets in the upper reaches of the Hudson, and even changes in barometric pressure—all these variations are reflected in the rise and fall of the tide.

The moon plays the leading rôle in the production of the tide and makes the length of the tidal day the same as its own, namely, 24 hours and 50 minutes. It is therefore found convenient to express time relations of the tide with reference to the time of the moon's passage over the meridian of any given place. In Figure 3 the rise and fall of the tide at Fort Hamilton is shown with reference to the time of the moon's passage over the meridian of Fort Hamilton, zero hours being the instant of the moon's passage over the meridian.

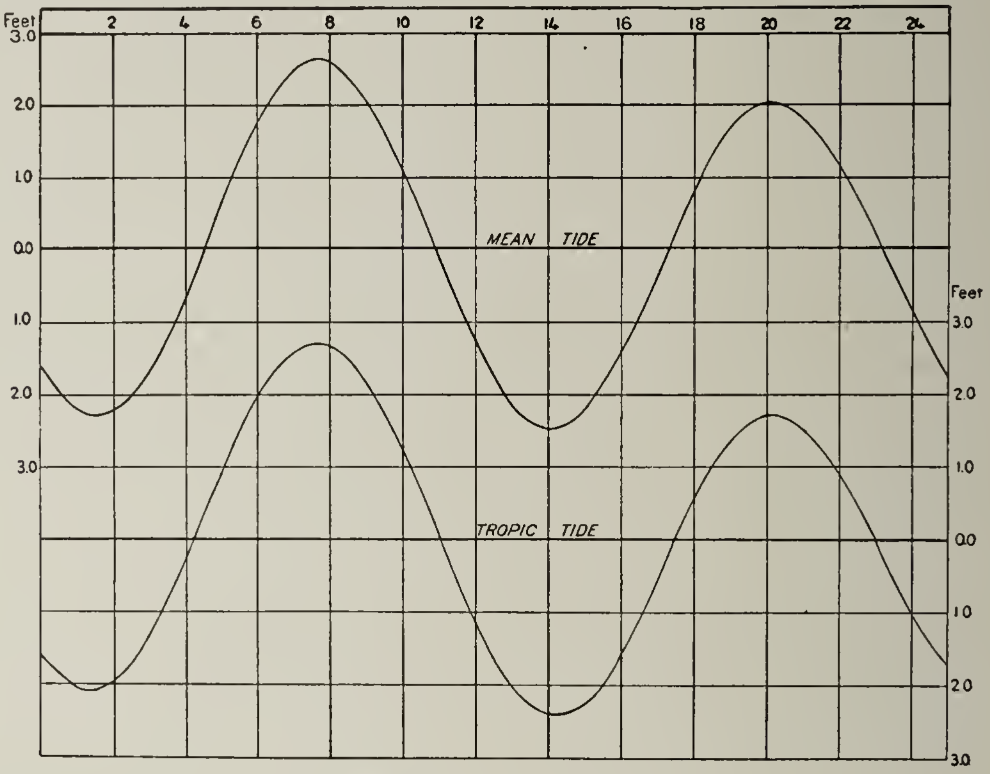

FIG. 3—Tide curves, Fort Hamilton, N. Y.

The upper diagram in Figure 3 represents the average conditions of the rise and fall of the tide at Fort Hamilton. A glance shows that in a tidal day, a period of 24 hours and 50 minutes, there are two complete cycles of rise and fall, giving in a day two high and two low waters. When the moon crosses the meridian of Fort Hamilton the tide is falling, and the fall continues an hour and 38 minutes longer, at which time low water is reached. The tide then begins rising, slowly at first, but at an increasing rate for about three hours, after which the rise takes place at a constantly decreasing rate for a like period of three hours until high water is reached, which occurs 7 hours 40 minutes after the moon has crossed the meridian. The average rise and fall of the tide, or the mean range of the tide, is 4.7 feet, the rise taking place in 6 hours and 2 minutes, and the fall in 6 hours and 23 minutes.

It is to be noted that the diagram represents average tidal conditions. Since the sun too is concerned in bringing about the rise and fall of the water, the time of tide is not absolutely fixed with relation to the moon's meridian passage. If the lunar constituent could be restrained from interfering, the component of the tide which the sun brings about would produce high water at Fort Hamilton about eight o'clock both morning and evening. This solar tide has at Fort Hamilton a rise and fall of but one foot; nevertheless it affects both the time and height of the lunar tide. The intervals by which high and low water follow the moon's meridian passage are therefore somewhat variable, though it is to be noted that at Fort Hamilton this variation is only infrequently as much as an hour. It is to be noted, further, that as regards the tide the "moon's meridian passage" has a special significance. It refers not only to the instant when the moon is directly above the meridian but also to the instant when the moon is directly below the meridian, or 180° distant in longitude. In this sense there are two meridian passages of the moon in a tidal day, and they are distinguished by being referred to as the upper and lower meridian passages.

The zero line of heights in the curves of Figure 3 represents the plane of mean sea level, and it is seen from the mean tidal curve that the two low waters of a day fall to different depths below sea level and likewise that the two high waters of the day rise to different heights. This variation in the heights of the two high waters or the two low waters of a day, known as the diurnal inequality, is found to be related to the moon's declination or its distance north or south of the equator. The diurnal inequality is greatest when the moon has its maximum declination and least when the moon is over the equator. In other words, in a period of about fourteen days the diurnal inequality goes through a complete cycle.

The mean tidal curve shows that at Fort Hamilton the average difference in the heights of the two low waters of a day is two-tenths of a foot, while in the high waters this difference is six-tenths of a foot. When the moon has its greatest semimonthly north or south declination the diurnal inequality in the heights of high or low waters is at a maximum, and the tides at such times are called "tropic tides" since the moon is then near one of the tropics. The lower curve in Figure 3 shows the character of the tide at such times. It is seen that the low water inequality has been changed but little, being at such times three-tenths of a foot; the high water inequality, however, now becomes one foot. In other words, the diurnal inequality in the tide at Fort Hamilton—and also throughout New York Harbor—exists principally in the high waters.

At times of full and new moon the tidal forces of sun and moon conspire and bring about a rise and fall of the tide greater than the average—the tides at such times being called "spring tides." At Fort Hamilton at such times the tide has a range 20 per cent greater than the mean range, the average rise and fall of the tide then being 5.6 feet. At times of the moon's first and third quarters the tidal forces of sun and moon are opposed, the tides then being known as "neap tides." At such times the tide at Fort Hamilton has a range of 3.8 feet, or 20 per cent less than the mean range.

The distance of the moon from the earth likewise affects the range of the tide. In its movement around the earth the moon describes an ellipse in a period of about 27½ days. When the moon is in perigee, or nearest the earth, the mean range of the tide at Fort Hamilton is increased by 23 per cent, becoming 5.8 feet. When the moon is farthest from the earth, or in apogee, the mean range of the tide is decreased by 20 per cent, being then only 3.8 feet.

It is to be noted, however, that in its response to the variations in the position of the moon relative to the earth and sun, the tide at Fort Hamilton is about a day behind the moon; that is the range of the tide is greatest, not on the day of full moon, but a day later. Likewise the range of the tide is greatest about one day after the moon is in perigee, and it is by an interval of a day that the neap tides follow the moon's first and third quarters. This lag in the response of the tide is known as the "age of the tide" and is generally ascribed to the effects of friction.

Since the period from one full or new moon to another is 29½ days while the period from one perigee to another is 27½ days, it is obvious that there will be times when the moon will be full or new and also in perigee. At such times we should expect the tide to have its greatest range. In 1916 on July 15 the moon was full and also in perigee. A day later we should therefore expect to find the tide at Fort Hamilton to have an unusually large range; in fact, some 40 per cent greater than the average, 20 per cent increase being due to full moon and 23 per cent to the moon's perigee. On July 16, 1916, the tide at Fort Hamilton, as shown by the automatic tide-gauge record, rose and fell through a vertical distance of 6.5 feet or 39 per cent more than the average.

Likewise, unusually small ranges of the tide should occur when the moon happens to be in apogee at the same time that she is in her first or third quarter. The range should then be decreased 20 per cent from its mean value because of the moon's apogee and a further 20 per cent because of neap tide, or a total of 40 per cent. On October 19, 1916, the moon was in apogee and also in its third quarter; and on the next day the tide-gauge record at Fort Hamilton shows the range of the tide to have been 3.2 feet or about 32 per cent less than the mean range.

In addition to the changes due to celestial conditions noted above, the rise and fall of the tide at Fort Hamilton is also considerably influenced by terrestrial conditions. This is to be expected for two reasons. In the first place the mobility of the water permits the wind to affect the time and height of the tide; and in the second place the Narrows acts as a funnel through which there is discharged into the sea the fresh-water run-off from a territory nearly 15,000 square miles[2] in area. This fresh-water discharge varies throughout the year, depending on the variations in rainfall and also on freshet conditions in the Hudson River above the Battery. Since the variations in wind and rainfall are largely of a seasonal nature, the tides at Fort Hamilton should likewise exhibit a seasonal variation. This is shown in Figure 4, which represents in diagrammatic form the average heights of high water and low water each month of the year as determined from observations extending over a period of 19 years, from 1902 to 1920.

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[2] Main Drainage and Sewage Disposal Works Proposed for New York City: Reports of Experts and Data Relating to the Harbor, *Rept. Metropolitan Sewerage Commission of New York, April 30, 1914*, 762 pp.; reference on p. 558.

The vertical lines represent the average monthly rise and fall of the tide at Fort Hamilton for each month of the year, the upper end of each of these vertical lines showing the average monthly height of high water, while the lower end shows the average monthly height of low water. The dotted horizontal line joining the upper ends of the vertical lines therefore represents the monthly changes in the height of high water, and the lower dotted horizontal line likewise represents the monthly changes in the height of low water. It is important to note that the seasonal variation in the height of the tide is the same for both high and low waters. In other words, this seasonal variation does not affect the range of the tide, but it does bring about a corresponding seasonal variation in sea level at Fort Hamilton.

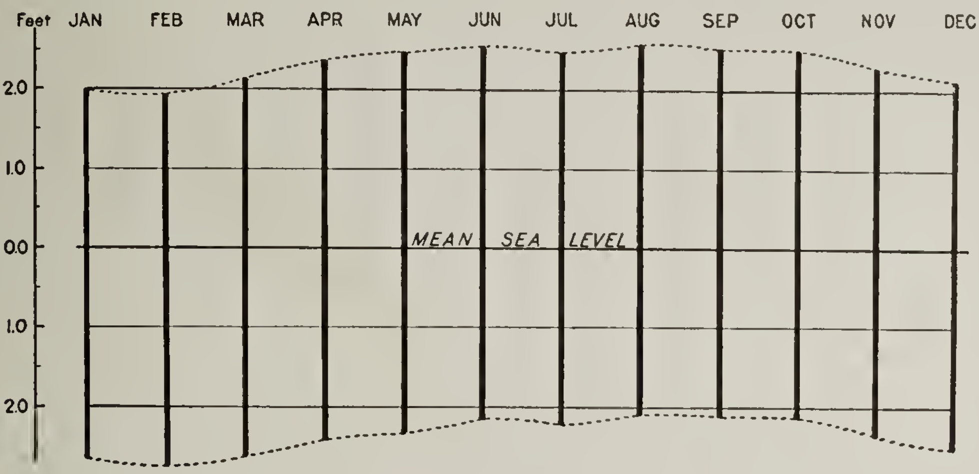

Fig. 4—Monthly variation in height of tide, Fort Hamilton, N. Y.

Figure 4 brings out the fact that, so far as seasonal changes are concerned, high water and low water at Fort Hamilton are lowest in the winter months with a minimum about the latter part of January, and are highest in the summer months with a maximum in the early part of August. Sea level at Fort Hamilton therefore goes through the same annual change, the difference in the average height of sea level as between the latter part of January and the early part of August being seven-tenths of a foot.

The monthly variations in the heights of the tide noted above are average variations; obviously the variations produced by any individual storm or freshet would be considerably greater. On December 7, 1914, a northeast gale that had been blowing for almost two days, with a velocity at times exceeding 60 miles an hour, brought about a tide which at high water stood 5.1 feet above mean sea level—almost 3 feet above mean high water.

The highest tide recorded at Fort Hamilton since 1893 was 6.1 feet above mean sea level. This occurred on April 11, 1918. The lowest tide observed at Fort Hamilton since 1893 occurred on February 2, 1908, when low water fell 6.5 feet below mean sea level, or 4.1 feet below mean low water. The extreme range, therefore, as between the highest and lowest tides observed at Fort Hamilton is 12.6 feet. Compared with the average range of 4.7 feet this extreme range is 170 per cent greater.

The characteristics of the tide at Fort Hamilton prove it to be very nearly the tide of the open coast. Thus, as compared with the tide at Atlantic City where an automatic tide gauge has been in operation for a number of years on the Million Dollar Pier, we find the tide at Fort Hamilton to be some 15 per cent greater in range, with higher water occurring 27 minutes later and low water 38 minutes later. At Atlantic City, too, the seasonal changes in the height of the tide are similar to those found at Fort Hamilton, sea level being lowest about the latter part of January and highest in August, the difference being five-tenths of a foot. A notable difference, however, between the tide at the two places is found in the relative periods of rise and fall. At Atlantic City the two periods are equal, both rise and fall occupying a period of 6 hours 12 minutes; but at Fort Hamilton, the period of fall is 21 minutes greater than the rise, this increase in period of fall giving evidence of the existence of features characteristic of river tides.

Currents in the Narrows

In the rising and falling of the tide in New York Harbor a very considerable mass of water passes through the Narrows—from the sea into the harbor on the flood and from the harbor into the sea on the ebb. This movement of the water in and out through the Narrows gives rise to tidal currents. The characteristics of these currents are shown in Figure 5, in which the upper curves represent in graphic form the velocities of the current expressed in knots or geographic miles per hour, as observed in the center of the channel off Fort Wadsworth on August 17, 1922. The velocities of the current are shown for three depths, 17 feet, 44 feet, and 70 feet, these depths being respectively two-tenths from the surface, five-tenths, and eight-tenths from the surface. The curves above the zero line of velocities represent the northerly or flood current, and the curves below the zero line represent the southerly or ebb current. For comparison there is also shown the curve of the tide at Fort Hamilton on the same date.

It is to be noted that the current curves reproduce the general features of the tide curve. For the Narrows a comparison of the simultaneous tide and current curves shows that the slack of the current comes about midway between the times of high and low water; maximum flood current, or "strength of flood," occurs near the time of high water; and strength of ebb occurs about the time of low water. These time relations between current and tide are characteristic of the progressive-wave type of tidal movement,[3] and we may therefore conclude that the tide in the Narrows is of the progressive-wave type.

An inspection of the current curves in Figure 5 brings to light the fact that the whole mass of water, from top to bottom, takes part in the tidal movement in and out through the Narrows. In two respects, however, the current curves for the different depths show unmistakable differences: the velocity of the current at the three depths is not the same, and the turn from flood to ebb (and vice versa) takes place at different times. These differences are due primarily to the fresh water discharged into the sea through the Narrows.

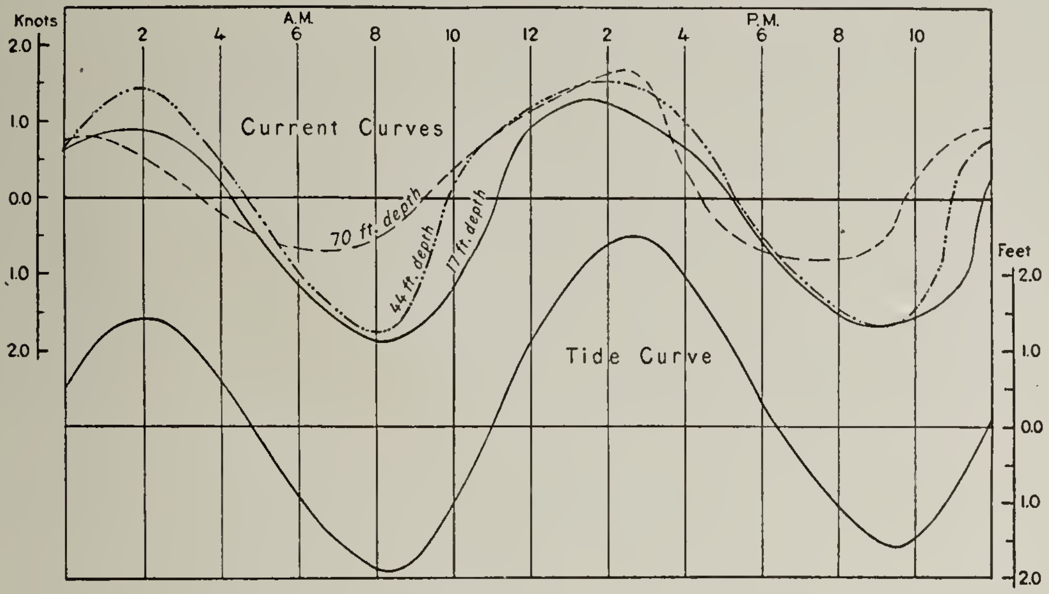

FIG. 5—Tide and current curves, the Narrows, New York Harbor, Aug. 17, 1922.

The streams tributary to New York Harbor bring to it at all times a very considerable amount of fresh water. During the months of March and April, when freshet conditions prevail, somewhat more than 50,000 cubic feet of this fresh or nontidal water is brought down every second to the Narrows to be discharged into the sea. And even during the month of August when the fresh-water run-off generally reaches its minimum, the fresh-water discharge through the Narrows is more than 13,000 cubic feet per second.[4]

Obviously the effect of this fresh water running continually toward the sea is to increase the duration and velocity of the ebb or outgoing current and to decrease the duration and velocity of the flood or incoming current. The 17-foot curve in Figure 5 brings this out clearly. But it is to be noted that the density of this fresh water is less than that of the saline water coming into the harbor from the sea. As a result the fresh water tends to keep toward the surface so that the effect mentioned should decrease from the surface downward. The 44-foot and 70-foot curves show this to be the case, the latter, indeed, indicating the greater duration and velocity for the flood current.

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[3] H. A. Marmer: Tides in the Bay of Fundy, *Geogr. Rev.*, Vol. 12, 1922, pp. 195–205; reference on p. 202.

[4] *Rept. Metropolitan Sewerage Commission of New York, April 30, 1914*, p. 558.

Since the current does not turn flood or ebb at the same instant from the surface to the bottom, it is evident that there will be times when the current near the bottom will be flowing in a direction opposite to the current near the surface. Thus from Figure 5 it is seen that at 10 A.M. on August 17, 1922, the current at the 17-foot depth was setting ebb, or southerly, with a velocity of about 1¼ knots, while at the same time the current at the 70-foot depth was setting flood, or northerly, with a velocity of ½ knot. It is to be observed, however, that at the time of strength the current from top to bottom is flowing in the same direction.

From day to day the tidal current undergoes changes which are related to the changes exhibited by the rise and fall of the tide. Full moon and new moon bring not only greater tides than usual but also stronger currents; likewise perigean tides mean stronger currents, while neap tides and apogean tides are accompanied by relatively weaker currents. In fact, from theoretical considerations the tidal current in the Narrows should vary in velocity as the tide varies in range, and this is borne out by the observations.

One other feature of the tidal movement in the Narrows should be mentioned, and that is the relation of the rising and falling tides to the flood and ebb currents. Figure 5 shows that from 2 A.M. to 8:20 A.M. the tide in the Narrows was falling; part of this time, however, the current was flooding—from 2 A.M. to 4 A.M.—and the rest of the time the current was ebbing. Similarly, from low water at 8:20 A.M. to high water at 2:30 P.M. the tide was rising; but during this period the current was ebbing part of the time and flooding the remainder of the time. And this state of affairs is characteristic of the tidal movement in the Narrows. On the first half of the rise the current is ebbing, on the second half it is flooding; on the first half of the fall the current is still flooding, but during the second half of the fall the current has turned ebb. The confusion that arises from identifying the rising tide with the flood current and the falling tide with the ebb current is clearly brought out by Figure 5.

Tidal Conditions in Upper Bay

The tide coming in through the Narrows progresses into Upper Bay at a rate dependent on the depth of the waterway, the rate of advance being given approximately by the formula $r = \sqrt{gd}$ in which r is the rate of advance, g the acceleration of gravity, and d the depth of water. At St. George, near the entrance to Kill van Kull, the tide is 20 minutes later than at Fort Hamilton; at Governors Island, at the mouth of East River, the tide is 25 minutes later; and in the entrance to Hudson River, abreast of Battery Place, it is 30 minutes later. Throughout Upper Bay the range of the tide is about 4.4 feet, or three-tenths of a foot less than in the Narrows. This decrease is not surprising in view of the considerable increase in the width of the tidal waterway north of the Narrows.

In its relation to the varying positions of sun and moon, and in its characteristics generally, the tide in Upper Bay is very much like the tide in the Narrows. The currents likewise reproduce the features of the current in the Narrows and, like the tides, are later in Upper Bay. The velocities of the current, however, are generally less than in the Narrows, corresponding to the decrease in the range of the tide.

TIDAL RÉGIME IN THE LOWER HUDSON

Past the Battery the tide from Upper Bay swings into the Hudson, and for a distance of 131 geographic miles, up to the state dam at Troy, the river carries the impulse of the tide. As it goes up the Hudson the tide acquires more and more the characteristics of river tides—the period of rise decreasing and the period of fall increasing—until at Troy the average period of rise is less than 5 hours, while the period of fall is increased to more than 7½ hours.

In ascending the river the time of tide becomes later, the distance to Troy being traversed in about 11 hours. This gives the tide a rate of advance of almost exactly 12 geographic miles per hour. In round numbers the average depth of the Hudson from its mouth to the head of tide water may be taken as about 20 feet. If in the formula for the rate of advance of a progressive wave, $r=\sqrt{gd}$, we substitute for d the value above, and for g 32.16 feet per second (this being the value of g for the latitudes of the Hudson), we get for r, the rate of advance, 25 feet per second, or 15 geographic miles per hour. Comparing this value with the actual rate of 12 miles per hour, we may conclude that the tide in the Hudson is primarily of the progressive-wave type.

At the mouth of the Hudson, abreast of Battery Place, the tide has a mean range of 4.4 feet. Going up the river the range decreases more or less regularly to West Point—a distance of 45 miles—where it averages 2.6 feet. The range then increases for a distance of a little more than 50 miles, attaining at Catskill a value of 4.1 feet. For the remaining distance of 35 miles the range again decreases, and at Troy it averages a little less than 3 feet.

In the upper Hudson both time and range of tide are very greatly affected by the amount of fresh-water run-off, and during the periods of heavy freshets the rise and fall of the tide is almost completely obliterated. In the lower Hudson, however, the effects of freshets are not so great; and in the stretch from the Battery to Spuyten Duyvil, the entrance to the Harlem, the tide is very much like that at Fort Hamilton. As regards time, the tide at Spuyten Duyvil is almost exactly 1½ hours later than at Fort Hamilton, and the mean range is 3.8 feet—decreasing gradually from 4.4 feet at the Battery. But, apart from these differences in time and range, the tide in the lower Hudson exhibits the features that characterize the tide at Fort Hamilton, and the tide curves shown in Figure 3 may be taken as typifying the tide in the river as far as the entrance to the Harlem.

The current phenomena in the lower Hudson, like the tidal phenomena, are similar to those in the Narrows. At the surface the ebb current has the greater velocity, but near the bottom the flood current is the greater. Throughout this stretch the velocity of the current at time of strength is approximately two knots at the surface and one knot near the bottom; strength of flood and ebb come respectively about the times of local high and low water, and slack current occurs midway between high water and low water. Figure 5, depicting the currents in the Narrows, may be taken as representative also of the currents in the lower Hudson.

From the Narrows, therefore, through Upper Bay and the lower Hudson, the tidal phenomena are very much the same, and likewise the current phenomena. Throughout this stretch the tidal movement is of the progressive-wave type; and this conditions the characteristics of both tides and currents, except as they are modified by the large amount of fresh water discharged through the Hudson.

Tides and Tidal Currents at the Eastern Gateway

The ocean tide that makes for New York Harbor from the east must traverse the waters of Long Island Sound before passing the eastern gateway to the harbor at Throgs Neck and entering East River. From the ocean the tide enters Long Island Sound through the Race where the average rise and fall is 2½ feet, high water and low water occurring about 1¾ hours later than at Fort Hamilton. Over the greater part of Long Island Sound the tidal movement is of the stationary-wave type, and it therefore follows that the times of high and low water change but little from one end to the other and that the range of the tide increases from the ocean entrance to the head of the Sound.[5]

At Throgs Neck the tide has a mean range of 7.2 feet, high water and low water occurring about 3¾ hours later than at Fort Hamilton. The tide curve representing the average rise and fall is shown in Figure 6, with reference to the time of the moon's passage over the meridian of Fort Hamilton. Throughout this paper the time of tide, when referred to the apparent revolution of the moon, will be taken with reference to the meridian of Fort Hamilton, since this procedure will make the time of tide at all places in New York Harbor directly comparable.

Comparing Figure 6 with the upper curve of Figure 3, which represents the mean curve of the tide at Fort Hamilton, it is seen at once that, apart from the difference in time and range, the tide curves for the two places exhibit differences in the character of the rise and fall. At Fort Hamilton the curve of the tide from high water to low water, and likewise from low water to high water, approximates closely to the cosine curve. At Throgs Neck, however, the rise and fall deviates from the cosine curve in that the tide curve is more rounded near the times of high and low water, giving a longer "stand" to the tide at those times.

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[5] Marmer, *op. cit.*, pp. 202-203.

At Fort Hamilton Figure 3 shows that for a period of two hours—from one hour preceding to one hour following high or low water—the tide changes about 0.35 foot. Expressing this as a percentage of the total rise or fall, we have the result that the tide at Fort Hamilton changes 7½ per cent of its range in the two-hour period that includes high or low water. At Throgs Neck a like change of 7½ per cent of the range covers a period of three hours. As a consequence of the relatively long stand of the tide at high and low water, the tide at Throgs Neck changes very rapidly about the time of mean sea level. For the period of two hours that extends one hour each side of mean sea level the tide changes in height 4½ feet, or more than 60 per cent of the total rise and fall.

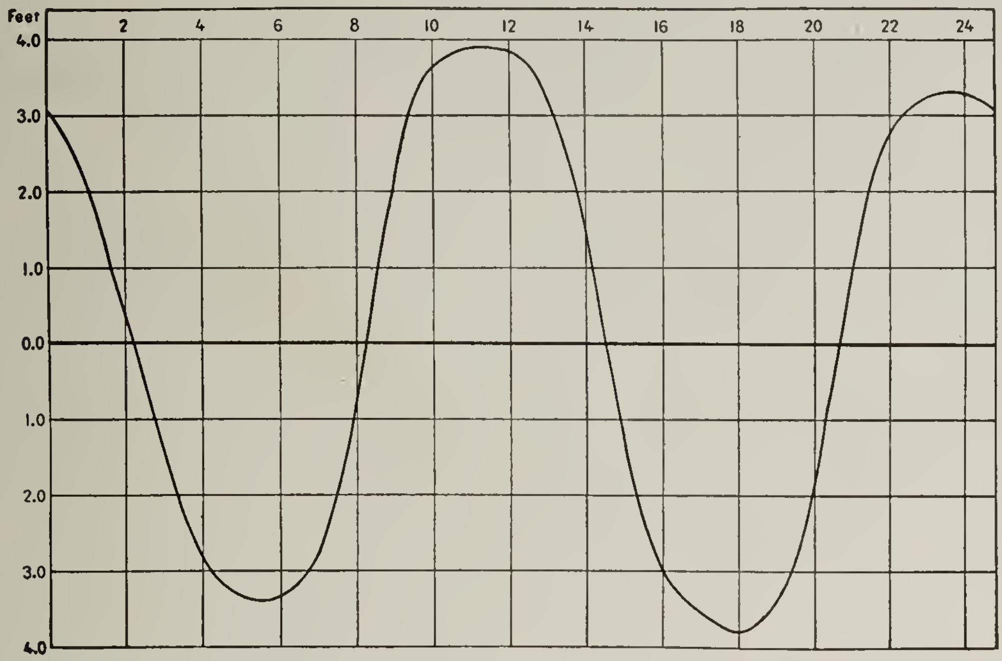

FIG. 6—Curve of the tide at Throgs Neck, at the eastern entrance to East River.

With regard to the changes in the rise and fall in response to the changing positions of the moon relative to earth and sun, the tide at Throgs Neck behaves much like that at Fort Hamilton. Spring tides are 19 per cent greater than the average, the range then being 8.5 feet, and neap tides are 21 per cent less than the average, having a range of 5.7 feet. Perigean tides bring ranges of 8.2 feet—15 per cent above mean range—and apogean tides bring ranges of 6.4 feet, or 11 per cent below the average. The tide at Throgs Neck shows somewhat more diurnal inequality in the low waters—0.4 foot for the average tide and 0.6 foot for the tropic tide—but in the high waters the inequality is very much like that at Fort Hamilton, being 0.6 foot on the average and 1 foot at the time of tropic tides.

The seasonal changes in the height of the tide at Throgs Neck are not so well determined as at Fort Hamilton, the observations extending over a shorter period. However, from the harmonic analysis of a series of tidal observations at Willets Point extending over a period of two years, it appears that in the eastern entrance to East River the tide is highest early in July and lowest early in January with a range of 0.3 foot, or about half the corresponding range at Fort Hamilton.

The currents in the channel abreast of Throgs Neck are much weaker than the currents off Fort Hamilton. Instead of velocities up to two knots, the currents here have velocities which, at strength, are barely over one knot. The characteristics of the tidal currents in the eastern gateway and the time relations of these currents to the tide are shown in Figure 7, which is a plotting of the observations made in the center of the channel between Throgs Neck and Willets Point on August 6, 1922. The current velocities at three depths are shown—at 22 feet, 55 feet, and 88 feet. These depths represent respectively distances from the surface two-tenths, five-tenths, and eight-tenths of the depth at that point. The curves above the zero line of velocities represent the westerly flowing current, and the curves below the zero line represent the easterly flowing current. For comparison the curve of the tide at Throgs Neck on the same day is plotted in the lower part of the diagram.

Exactly the same time and velocity scales are used in Figure 7 as in Figure 5. A glance at the two figures shows that, despite the fact of a considerably greater range of the tide in the eastern gateway, the currents here have a velocity approximately half that at Fort Hamilton. Attention is called to this fact to emphasize the necessity of distinguishing between tide and current at any place. To say that at a given point there is a "strong tide" is not very enlightening, for what is probably meant by such a statement is not that the tide has a relatively large range but that the current has considerable velocity.

Now it is to be noted that, while at any given point the velocity of the current changes from day to day as the range of the tide changes, it does not at all follow that as between two places having different ranges of tide the larger range is accompanied by the stronger current. Fort Hamilton and Throgs Neck furnish one example in illustration of this; but a still better one is furnished by a comparison of the tides and currents at the two ends of Long Island Sound. In the Race, the entrance from the ocean to Long Island Sound, the tide has a range of 2.5 feet but is accompanied by a current of 3.5 knots or more; at Throgs Neck the range of tide is 7.2 feet, while the velocity of the current is barely one knot.

Two factors determine the velocity of the current in coastal or inland tidal waters at any point along the channel. The first is the volume of water that must flow through the channel past the point, and the second is the area of the cross section of the channel at that point. It is the latter factor that generally makes the current, more than the tide, immediately responsive to changes in geographic or hydrographic features. A change in the cross-sectional area of a tidal waterway produces a change in the velocity of the current, even though the range of the tide be not perceptibly changed.

One of the characteristic features of the stationary-wave type of tidal movement is that the slack of the current comes at the times of high and low water, while the strength of the current comes midway between high and low water.[6] Figure 7 brings out the fact that off Throgs Neck the slack of the current comes, approximately, midway between high and low water and the strength of the current about the times of high and low water. In this respect the current here resembles the current off Fort Hamilton, where the tidal movement is of the progressive-wave type. In the channel off Throgs Neck, therefore, the time relations of current and tide have been very considerably modified from those prevailing over the greater part of Long Island Sound. Here it will be sufficient to note merely that this change is brought about by the transition from the stationary-wave movement in Long Island Sound to the type of tidal movement that prevails in East River.

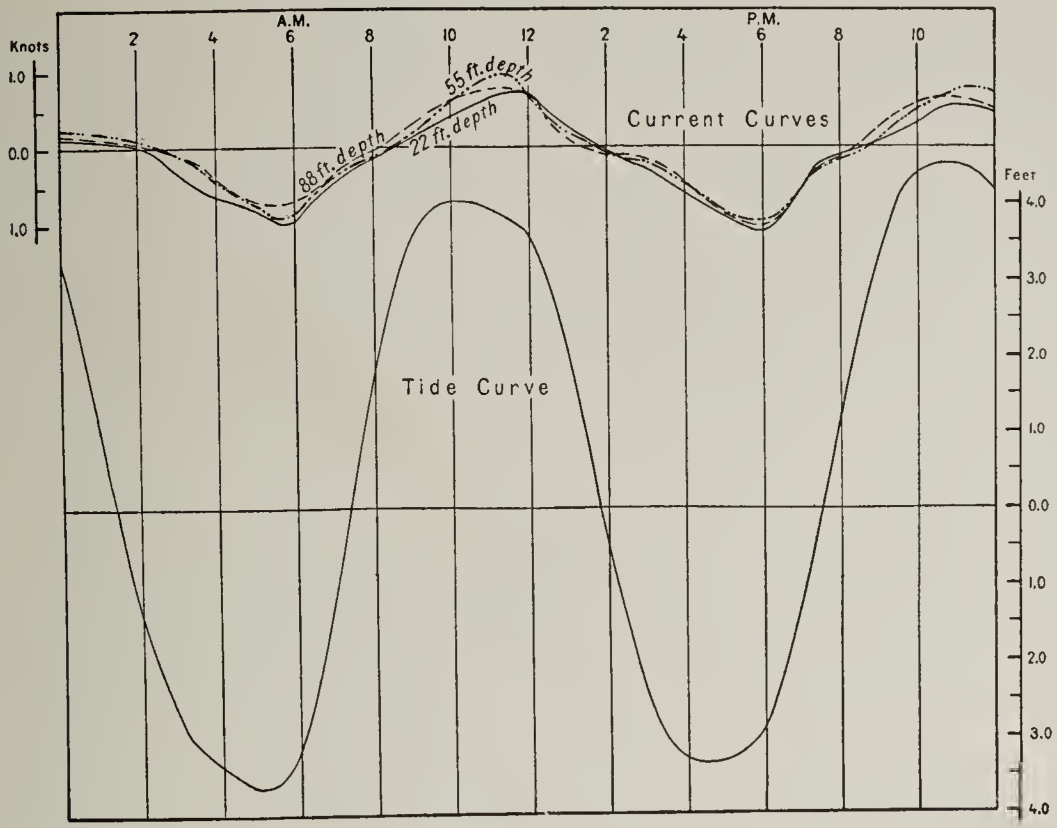

FIG. 7—Tide and current curves off Throgs Neck, East River, New York, Aug. 6, 1922.

Past Throgs Neck the Long Island Sound tide enters East River at its eastern end. About fourteen miles southwesterly the ocean tide that has come in through the Narrows passes Governors Island and enters East River at its western end. The tides at Throgs Neck differ considerably from those at Governors Island in time, range, and characteristics of rise and fall. These differences give rise to tidal phenomena in East River which at first glance appear perplexingly involved; but before discussing these phenomena it will be of advantage to consider somewhat more fully four matters relating to tides and currents which are of particular significance in the tidal movement of the water in East River. These matters are: the velocity of tidal currents and the rate of advance of the tide; the distance traveled by a particle during a tidal cycle; the direction of flood in a strait; and the duration of slack water.

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[6] Marmer, *op. cit.*, p. 202.

Velocity of Tidal Currents and Rate of Advance of the Tide

In the movement of water brought about by the tide, it is important to distinguish clearly between the velocity of the current and the rate of advance of the tide. In the former case we are dealing with the actual speed of a moving particle while in the latter we are dealing with the velocity of propagation of wave motion, which generally is many times greater than the velocity of the current. Thus in the lower Hudson the currents have a velocity of about 2 knots at time of strength. But the rate of advance of the tide in the Hudson was found to be about 12 miles per hour, or six times as great as the velocity of the current.

Now it is to be noted that there is no necessary relationship between the velocity of the tidal current and the rate of advance of the tide; in other words, if the rate of advance of the tide at any place is given we cannot from that alone infer the velocity of the current at that place nor vice versa. The rate of advance of the tide depends on the type of tidal movement. In a progressive wave the tide moves in accordance with the formula $r=\sqrt{gd}$. In stationary-wave movement, since high water or low water occur at very nearly the same time over a considerable area, the rate of advance is theoretically very great; but actually there is always some progression present, and this reduces the theoretical velocity considerably.

The velocity of the tidal current at any point, or the actual speed with which the particles of water are moving, depends on the volume of water that must pass the given point and the cross section of the channel at that point. The velocity of the current is thus independent of the rate of advance of the tide.

Distance Traveled by a Particle During a Tidal Cycle

If the velocity of the current during a tidal cycle were constant, the distance traveled by the water particles or by any object floating in the water would be given by multiplying the velocity by the time. The velocity of the current, however, is not constant but changes continually throughout the tidal cycle. The distance traveled by the water particles is therefore the average velocity during any interval multiplied by the time.

The average velocity of the current during any given interval may be determined in a number of ways. By measuring the velocity on the current curve at frequent intervals—say every 10 or 15 minutes—the average velocity is easily derived. Or we may determine the area of the surface bounded by the current curve and the zero line of velocities, by means of a planimeter, and derive the average velocity by dividing this area by the length of the zero line included within the current curve.

Much the simplest method, however, consists in making use of the well-known ratio of the mean ordinate of the cosine curve to the maximum ordinate, which is $2 \div \pi$, or 0.637. Since the velocity of a tidal current is almost invariably specified by its velocity at time of strength—which corresponds to the maximum ordinate of the cosine curve—the average current, by this method, is given immediately by multiplying the strength of the current by 0.637. It is to be noted, however, that this method is only approximate, since the curve of the current may deviate more or less from the cosine curve; but for all practical purposes the results will be sufficiently accurate.

Applying the above rule in the case of a current having a velocity of 2 knots at time of strength, a floating object will be carried, during a flood or ebb period of 6.2 hours, a distance of $0.637 \times 2 \times 6.2$ geographic miles, or 48,000 feet. It may be of interest to note here that for the Hudson River and Upper Bay the distance traveled by a floating object, calculated as above, was found to agree closely with that actually traversed by a float.[7]

What Is Flood in a Strait?

As ordinarily understood, the flood current is the one that sets inland or upstream, and the ebb current the one that sets seaward or downstream. This usage leads to no confusion in the case of bays and rivers, since there can generally be no question as to which direction is upstream and which downstream. But in the case of a strait which connects two bodies of water each of which has an independent passageway to the sea the terms upstream and downstream no longer have precise meanings.

East River furnishes a case in point. Parenthetically it may here be remarked that the term river applied to this waterway is a misnomer, for East River, so called, is a strait connecting Upper Bay and Long Island Sound. The mariner entering East River from the east may, not inconsistently, claim that he is going inland or upstream, and hence the current setting into East River past Throgs Neck—the westerly-setting current—would by him be called the flood current. But a fellow-mariner entering East River from the west—past Governors Island—can with as much show of consistency claim to be going upstream and thus call the easterly-setting current flood. What is the way out of this dilemma?

The tidal mathematician here comes to our rescue. Instead of speaking of flood and ebb in a strait in terms of upstream and downstream, he makes use of the time relations of current and tide. Flood he defines as the current which attains its maximum velocity or strength on a rising tide, and ebb the current which attains its strength on a falling tide.[8] This gives a simple and at the same time a rigorous criterion for determining in all cases which current is to be called flood and which ebb. Furthermore, this definition of flood and ebb gives to the currents in tidal bays and rivers the same designation as does the definition based on the notions upstream and downstream.

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[7] H. de B. Parsons: Tidal Phenomena in the Harbor of New York, *Trans. Amer. Soc. of Civil Engineers*, Vol. 76, 1913, pp. 1979–2106 (discussion, pp. 2094–2106); reference on p. 2028.

Duration of Slack Water

Where the current at time of strength attains a velocity of two knots or more, it becomes a matter with which the navigator must reckon; and where a velocity of five knots or more exists, as for example in Hell Gate, East River, it may become necessary for the navigator to await the time of slack water before attempting to make the passage. The question is therefore frequently raised, How long does slack water last?

To this seemingly simple question no direct answer can be given, for it all depends on just what is meant by the term slack water. A glance at Figures 5 and 7 shows that the time during which the current has no movement is but a moment—the instant when the current curve cuts the zero line of velocities—and hence when the tidal mathematician speaks of slack water he has in mind that mathematical instant. Apart from the mathematician, however, slack water is thought of as a period of time extending over a number of minutes during which the current is at a standstill, neither flooding nor ebbing. And the layman is at a loss to understand why no direct answer is given to his simple question, How long does slack last?

Now if we consider the period of slack water to be the interval of time during which the velocity of the current is so small that for *practical purposes* it may be disregarded, we make the term connote the meaning attached to it in ordinary usage. Current velocities less than one-tenth of a knot may for all practical purposes be disregarded; and, furthermore, such velocities are difficult to measure either with float or with current meter. We may therefore give the term slack water a definite meaning in ordinary usage by defining it to be the period during which the velocity of the current is less than one-tenth of a knot.

Setting one-tenth of a knot as the limit of slack water is, to be sure, somewhat arbitrary. But for the reasons noted above this limit appears better than one greater or less. And slack water so defined now permits us to answer the question, How long does slack water last? For all that need be done is to measure, on the current curve for any given place, the interval during which the velocity of the current is less than one-tenth of a knot. For example, from the current curves in Figure 5 we find that in the Narrows, at a depth of 17 feet, slack water lasts about 10 minutes.

It is obvious that with strong currents the duration of slack water is relatively short while with weak currents it is greater. In fact, where the current curve does not deviate very much from the cosine curve the duration of slack water is a function of the strength of the current. Regarding the current curve as approximately a cosine curve, we may compute the duration of slack water directly from the equation of the cosine curve; for if we write this equation in the form $y = A \sin 0.483t$ in which A is the velocity of the current at time of strength, 0.483 the number of degrees per minute in a tidal period of 6.2 hours and t the time in minutes from the moment of zero velocity, we have for deriving the duration of slack water the equation $0.1 = A \sin 0.483t$. It is to be noted that the value of t derived from the above equation gives one-half the duration of slack water, the total period of slack being $2t$.

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[8] R. A. Harris: Manual of Tides, Part V: Currents, Shallow-Water Tides, Meteorological Tides, and Miscellaneous Matters, *U. S. Coast and Geodetic Survey Rept. for the Year Ending June 30, 1907*, Washington, D. C., 1907, pp. 231–545 (=Appendix 6); reference on p. 338.

Based on the above equation the following values for the duration of slack water have been computed. With currents which at strength have a velocity of one knot the duration of slack water, that is the period during which the velocity of the current is less than one-tenth of a knot, is 24 minutes; with currents of two knots strength, 12 minutes; three knots, 8 minutes; four knots, 6 minutes; five knots, 5 minutes.

The Tide in East River

From Upper Bay, past the Battery, East River carries the tide northeastward while the Hudson River carries it northward. The average depth of East River is approximately the same as that of the lower Hudson from the mouth to Spuyten Duyvil, being in both cases approximately 30 feet.[9] The distances too are very nearly the same, the channel of East River from the Battery to Throgs Neck measuring fourteen geographic miles, while that of the Hudson River up to Spuyten Duyvil measures twelve miles. The tide, however, takes but an hour to traverse the twelve miles up the Hudson, while in the fourteen miles of East River there is a change of 3¼ hours in the time of tide.

It is to be noted, too, that in the Hudson the time of the tide changes in a uniform manner from the Battery to Spuyten Duyvil, each mile being traversed in approximately five minutes. In East River this is not the case. In the first six miles—from the Battery to the northern end of Blackwells Island—the tide becomes later by two hours, the change taking place in a relatively uniform manner; that is for each mile there is a change of about 20 minutes in time of tide. From the end of Blackwells Island through Hell Gate the time of tide changes very rapidly, this stretch of a mile and a half showing a change of 1½ hours, or a change at the rate of 60 minutes for each mile. For the next three miles there is practically no change in the time of tide, and for the remaining three and a half miles to Throgs Neck there is a change in the opposite direction, the tide actually becoming earlier by a quarter of an hour.

Not only in time but also in range of tide do the two waterways exhibit marked differences. From a range of 4.4 feet at the Battery the tide in the Hudson decreases to 3.8 feet at Spuyten Duyvil, this decrease of 13½ per cent in the range taking place in a uniform manner throughout the stretch of twelve miles, or at the rate of a little over one per cent per mile. In East River, from the range of 4.4 feet at the Battery the tide increases to a range of 7.2 feet at Throgs Neck—an increase of 63½ per cent—but this increase is not uniform over the stretch of fourteen miles.

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[9] *Rept. Metropolitan Sewerage Commission of New York, April 30, 1914*, p. 548.

For the first three miles from the Battery the tide, instead of increasing, actually decreases almost one-half of a foot, the rise and fall of the tide a little north of the Navy Yard being exactly 4 feet. After this initial decrease the tide begins to increase in range, mounting steadily each mile until at Throgs Neck 7.2 feet is attained. In the first three miles, therefore, the tide in East River decreases at the rate of 3 per cent per mile, while for the remaining eleven miles there is an increase in the range at the rate of 7¼ per cent per mile.

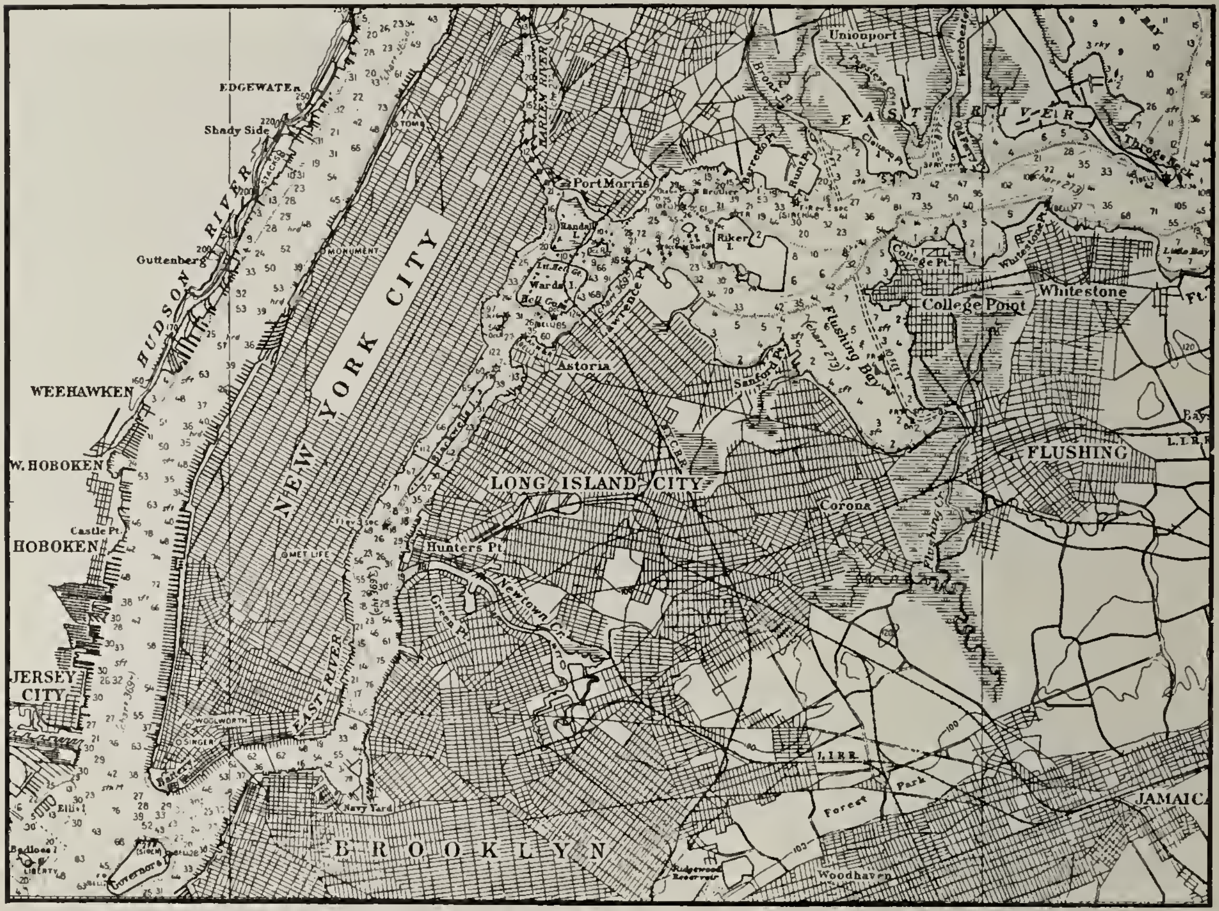

FIG. 8—East River and portions of the Hudson and Harlem Rivers. Reduced from *U. S. Coast and Geodetic Survey Chart No. 1213.*

Now it is important to note that this behavior of the tide in East River, so strikingly different in regard to both time and range from the tide in the waters around it, cannot be ascribed to any peculiar hydrographic or geographic features of the waterway itself. As we shall see later in the discussion of the character of the tidal movement, the time and range of the tide in East River are conditioned by the fact that East River is a short strait connecting two bodies of water having tides independent of each other.

As regards the characteristics of the rise and fall of the tide throughout East River, it may be said that from the Battery to Hell Gate the tidal curves are very much like those for Fort Hamilton shown in Figure 3, while in the stretch from Hell Gate to Throgs Neck the tide curves exhibit the more rounded appearance of the tide at Throgs Neck shown in Figure 6.

THE CURRENT IN EAST RIVER

From the Battery the current in the Hudson River, like the tide, becomes later in going upstream, so that at Spuyten Duyvil both strength and slack of the current come very nearly one hour later than at the Battery. In East River conditions are reversed, the slack and also the strength of current occurring earlier in going up the river from the Battery, the time of the current at Throgs Neck being almost exactly one hour earlier than at the Battery.

It is to be recalled that the time of *tide* becomes later from the Battery to Throgs Neck by 3¼ hours. Since the time of current in the same stretch becomes earlier, it is obvious that the relation of the time of current to the time of tide varies considerably from one end of the river to the other. At its western end, off the Battery, the current that sets into East River—the easterly-flowing current—attains its strength about 4½ hours after local low water. Abreast of Throgs Neck, at the eastern end of the river, this same current attains its strength about half an hour after low water.

The easterly-setting current, therefore, throughout the whole extent of the East River, attains its strength between the times of low water and high water. Since by definition the flood current is the one that attains its strength on a rising tide, the flood current in the East River is the easterly-flowing current, the one that sets from Upper Bay into Long Island Sound. The westerly-flowing current, that sets from Long Island Sound into Upper Bay, is therefore the ebb current. In this connection it may be of interest to note that these designations, which follow from the tidal mathematician's definition, are also the ones that have been applied to the easterly and westerly currents of the East River by the pilots.[10]

The swiftest currents found in New York Harbor occur in East River. The average velocity at time of strength throughout the stretch from Governors Island to Throgs Neck is about 2½ knots, but this velocity varies from place to place in accordance with the variation in cross section of the waterway. In Hell Gate and in the channel to the west of Blackwells Island the area of the cross section is greatly reduced, and here velocities of five knots and more are of frequent occurrence.

As regards the characteristics of the currents, East River may be considered as consisting of two parts, with Hell Gate as the connecting link.

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[10] *U. S. Coast Survey Rept. for the Year 1867*, Washington, D. C., 1869, p. 161.

In the lower part—from the Battery to Hell Gate—the westerly, or ebb, current has the greater velocity. In the upper part—from Hell Gate to Throgs Neck—it is the flood, or easterly, current that has the greater velocity. Furthermore, in lower East River the currents exhibit practically no effects of fresh or non-tidal water, while in upper East River the effects of fresh water are distinctly evident but only in the easterly-flowing current.

Character of Tidal Movement in East River

In the discussion of tidal phenomena it is frequently of advantage to employ terms that relate to wave motion. Thus we speak of the advance of the *tide wave*, of high water as the crest of the tide wave, and of low water as the trough; the two principal types of tidal movement are designated as the progressive-wave and stationary-wave types. In terms of wave motion, therefore, the tidal movement in the East River is frequently described as resulting from the "interference of the two tidal waves, the one entering from Upper Bay and the other from Long Island Sound."

Notwithstanding the advantages accruing from the conception of the tide in terms of wave motion, its application to the tidal movement in the East River is unfortunate. To ascribe the tidal and current phenomena in this waterway to the "interference of tide waves" relegates the whole matter to the mathematician and enshrouds the mechanism of the movement, which in reality is quite simple, with a terminology which makes it inexplicable in non-mathematical language. Moreover, it frequently leads to absurd statements; as for example, that "the two tide waves, entering East River from Upper Bay and from Long Island Sound, meet in a high water crest somewhere east of Whitestone Point."

The movement of the water in East River is brought about by the fact that part of the time the level of the water in Upper Bay is higher than in Long Island Sound and part of the time it is lower. East River thus acts merely as a channel through which the water flows from the body having, temporarily, the higher level to the one having the lower level. In other words, the movement of the water in East River is primarily hydraulic in character.

From simple hydraulic considerations it is evident that when the level of the water at the two ends of East River is the same no movement of the water can take place; but as soon as a difference in level arises, the water will flow towards the body having the lower level. Furthermore, the velocity of this current increases as the difference in level increases, the maximum velocity or strength of current coming at the time of greatest difference in level. Hence, if we plot the heights of the tide at the two ends of East River, the lines joining simultaneous heights will indicate by their slope the difference in level; and, if the reasoning above applies, we should expect slack water about the time of zero slope and strength of current about the time of maximum slope.

In Figure 9 the simultaneous heights of the level of the water at the two ends of East River are represented for each hour of the tidal rise and fall, time being reckoned from the instant of the moon's passage over the meridian of Fort Hamilton. On the vertical line to the left the hourly height of the tide is plotted as taken from the mean tide curve for the Battery, while on the vertical line to the right the hourly heights are taken from the mean tide curve for Throgs Neck. In both cases the heights are measured from mean sea level, indicated by the heavy horizontal line, the scale of heights in feet being shown to the left. The figures along the vertical lines denote the hours to which the indicated heights apply, the hours and heights being placed to the left of each vertical line for the rising tide and to the right for the falling tide. The slope lines—the lines joining simultaneous heights—are drawn full when the slope is from Long Island Sound to Upper Bay, and dashed when the slope is in the reverse direction.

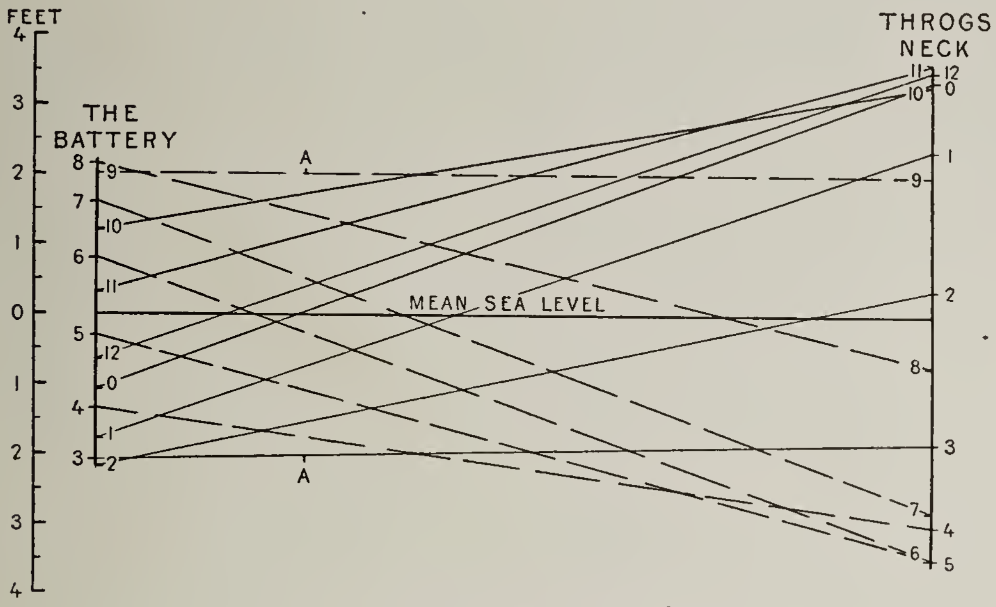

Fig. 9—Slope-line diagram, East River.

If the movement of the water in East River is due to the difference of level at the two ends, as pictured in Figure 9, then high water at any given place in the river is the highest point in the slope lines passing that place, and low water is the lowest point in the slope lines. Furthermore, the times of high and low water at that place are given immediately by the respective slope lines on which the highest and lowest points are found. For example, at A, one fourth the distance between the Battery and Throgs Neck, the highest point is on the 9-hour slope line, and the lowest point is on the 3-hour line. On the scale in feet to the left these points are respectively 2 feet above and 2 feet below mean sea level. Hence the height to which high water at point A rises is 2 feet above sea level, and the depth to which low water falls is 2 feet below sea level, giving a range at that place of 4 feet—less, be it noted, than the range at the Battery. The time of high water at A, with respect to the moon's passage over the meridian of Fort Hamilton, is obviously 9 o'clock and the time of low water 3 o'clock.

From the diagram it is evident that the highest points of the slope lines define the curve of the high waters in the river, while the lowest points define the curve of the low waters. The diagram, therefore, shows at once that from the Battery the range of the tide decreases for about one-quarter the way to Throgs Neck, after which it increases. And this, it is to be recalled, we found to be the case. Furthermore, the diagram gives the smallest range in the river as 4 feet, which figure is exactly that found by actual observation. This decrease of the range in the first three miles of East River—which upon being shown by observation to exist has generally been ascribed, in a vague way, however, to the "interference of tide waves"—is thus shown to follow immediately by considering the movement of the water to be hydraulic.

One other feature of the tides in East River merits more than passing mention because of its practical importance, and that is the line of low water in the river. This line, instead of being a straight line between the Battery and Throgs Neck, as might be expected at first thought, is shown by the hydraulic diagram of Figure 9 to be a curved line convex toward the surface. This is characteristic of the low water line in a waterway which connects two independent tidal bodies of water, and its practical importance lies in the fact that in the deepening of such a waterway a considerable saving in excavation may frequently be made. For instead of dredging the bottom to a uniform depth below mean sea level, advantage may be taken of the fact that the low water line for some distance lies above the straight line joining the low water points at the two ends.

The current phenomena in East River likewise may be derived from the hydraulic diagram of Figure 9. Thus, the times of slack and of strength of the current should obviously be very nearly simultaneous throughout the river, the former occurring when the difference in level at the two ends is zero and the latter when the difference is greatest. From Figure 9 we find that, with reference to the time of the moon's passage over the meridian of Fort Hamilton, the water at both ends is at the same level a little after 3 o'clock and also at 9 o'clock. From observations it is found that the time of slack water changes but little throughout the river, the average time being a few minutes later than given by the diagram.

The greatest slope towards Upper Bay is shown by the 1-hour line, and hence the strength of the westerly current should come about 1 o'clock; the greatest slope towards Long Island Sound is shown by the 7-hour line and the strength of the easterly-flowing current should come about 7 o'clock. Observations show that these times are approximately the times of strength of the respective currents throughout the river.

It is obvious that the simple hydraulic considerations on which Figure 9 is based can give only a first approximation to the tidal and current conditions existing in East River. No account has been taken of the varying depths in the waterway, of the differences in width and changes in direction, nor of the effect of the water coming through Harlem River. The slope lines are drawn as if the channel from the Battery to Throgs Neck ran straight for the stretch of fourteen miles with unvarying width and depth. However, notwithstanding the modifications that must arise from the fact that East River deviates from the uniform channel assumed in Figure 9, the principal tidal and current phenomena in the river are easily derived by considering the movement of the water in East River as hydraulic. The outstanding advantage of regarding the phenomena from the hydraulic point of view is that it permits us to visualize the mechanism of the movement of the water.

TIDES AND CURRENTS IN HARLEM RIVER

Harlem River is a strait, about six geographic miles in length, connecting the Hudson with East River. At Spuyten Duyvil, the entrance from the Hudson, the tide has a mean range of 3.8 feet and is 1½ hours later than at Fort Hamilton. At the East River end of the Harlem the tide has a range of about 5 feet and is 2½ hours later than at Fort Hamilton. The conditions in the Harlem are therefore similar to those in East River, the tides and currents being due to the difference in level of the water at the two ends.

It follows, therefore, at once that the time of the current throughout the Harlem will be practically the same. The current will be slack when the water at the two ends is at the same height, while it will be at its maximum velocity when the difference in the level of the water at the two ends is greatest. A slope line diagram, drawn as in Figure 9, will enable the times and ranges of the tide and also the time of strength and slack of the current to be determined. However, owing to the fact that the difference in time of tide at the two ends of the Harlem is but one hour while for the two ends of East River this difference is 3¼ hours, the slope lines for the strength of the current in the Harlem are not as steep as in East River, and hence the currents are not as strong.

The southerly-setting current—the one that carries the waters of the Hudson into East River—attains its strength about 2¾ hours before high water in the Harlem, that is while the tide is rising. Hence in the Harlem it is the southerly-setting current that is the flood current. The ebb current, flowing from East River toward the Hudson, attains its strength about 3½ hours before low water. Throughout the river the ebb current has a slightly greater velocity, the average velocity for the center of the channel being about 1¼ knots for the flood and about one-tenth of a knot more for the ebb. Under the bridges, however, where there is a constriction in the waterway, the velocity of the current exceeds two knots at strength.

TIDES AND CURRENTS IN KILL VAN KULL

The tidal and current phenomena in Kill van Kull are similar to those in the Harlem. For the Kill van Kull is a short strait—measuring three geographic miles in length—connecting Newark Bay with Upper Bay. On the Newark Bay end the tide has a range of 4.7 feet and is about 40 minutes later than at Fort Hamilton. On the Upper Bay end the tide has a range of 4.4 feet and is 20 minutes later than at Fort Hamilton. This difference in the tides at the two ends of 20 minutes in time and 0.3 foot in range gives rise to tidal currents which in the center of the channel have a velocity of from 1 to 2 knots.

Since there is but 20 minutes difference in the time of tide at the two ends of the Kill; the time of tide as well as the time of current is practically simultaneous throughout the Kill. The flood current, as a slope-line diagram shows, is the westerly flowing current, and the ebb current is the easterly one. Strength of flood comes about 2 hours before the time of high water at Fort Hamilton, and strength of ebb comes about 2½ hours before low water; with respect to the time of local tide this is 2¼ hours before high water and 2¾ hours before low water.

Circulation of the Sea Through the Harbor

In consequence of the tide, there is a ceaseless interchange of water between the harbor and the sea. For a period of approximately six hours, on the flood, the sea pours its waters into the harbor, and in the following period of six hours the harbor waters move toward the sea.

The current does not turn to flood or ebb at the same time throughout the various parts of the harbor. It turns earliest in Kill van Kull and latest in the Hudson, but this difference is only three hours. For the remaining three hours of the flood or ebb cycles the current will be flooding or ebbing throughout the whole harbor. Figure 10 is a schematic representation of the current in the component parts of New York Harbor one hour before the time of high water at Fort Hamilton. At this time the current throughout the harbor is running flood at very nearly its strength. Through the Narrows the ocean waters are now pouring into Upper Bay with the greatest force, carrying into the harbor at this time about three-quarters of a million cubic feet each second; in Kill van Kull the strength of the current occurred one hour before; in East River the current is just about at its strength setting towards Long Island Sound; in the Harlem likewise the current is about at its strength, flowing into East River, while in the Hudson the current is gathering momentum for the strength which will occur about 1½ hours later.

Figure 11 represents the conditions six hours later, or one hour before the time of low water at Fort Hamilton. Throughout the harbor the current is running ebb at very nearly its strength. For 1½ hours the Hudson has been returning the tidal water received on the previous flood together with the fresh-water run-off from the thousands of miles of territory it drains; but the strength of the ebb in the Hudson is still 1½ hours away. The Harlem is now running at its strength carrying the waters of the Hudson toward East River, while in the latter the current is setting toward

Upper Bay, the strength of the current having occurred about half an hour previously. In Kill van Kull the strength of the ebb is 1½ hours past, but the waters of Newark Bay are still flowing into Upper Bay. Gathering the ebb waters from the Hudson River, East River, and Kill van Kull, Upper Bay pours them out to sea through the funnel of the Narrows, though it is to be noted that at this time—one hour before low water at Fort Hamilton—the current through the Narrows is still about an hour from its strength.

For the port of New York and for the communities situated along the banks of the tidal streams tributary to the harbor this interchange of water consequent on the tide is of importance in connection with the maintenance of the channels and the disposal of sewage. In the maintenance of the channel of a waterway tidal currents are of importance, since sand will be moved along the bottom of the channel by a current of 2/5 of a knot, fine gravel by a current of 1 knot, shingle 1 inch in diameter by a current of 2½ knots, and angular stones 1½ inches in diameter by a current of 3½ knots.[11] In the disposal of sewage the tidal action is of a twofold character. In the first place, the tidal currents carry some of the solid and liquid ingredients out to sea; and, secondly, the uncontaminated sea water brought into the harbor on the flood aids in assimilating the sewage and thus converting it into inert mineral matter.

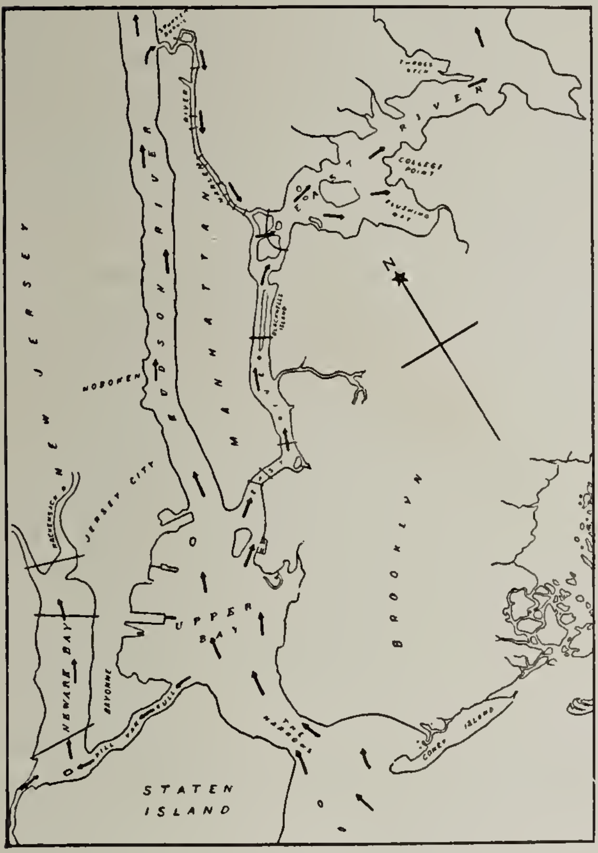

FIG. 10—Flood in New York Harbor.

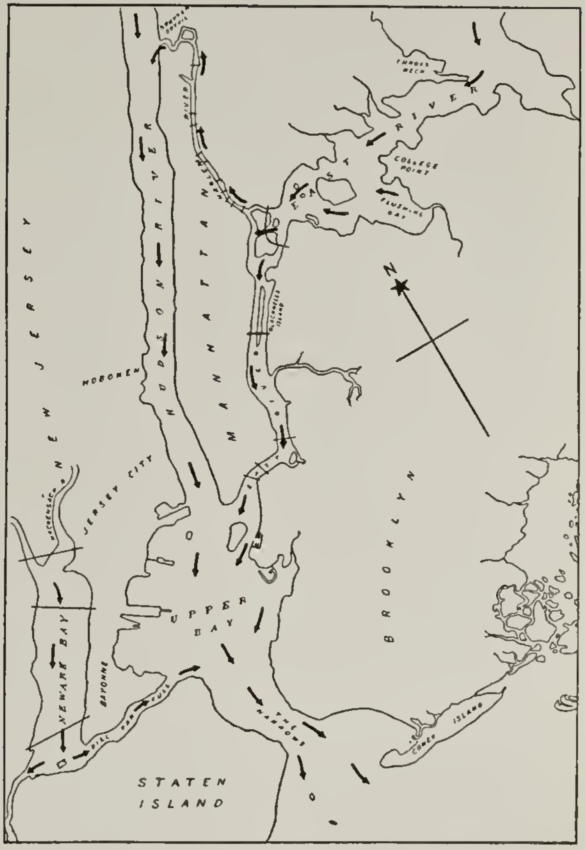

FIG. 11—Ebb in New York Harbor.

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[11] Harris, *op. cit.*, p. 423.

The determination of the quantity of water passing in and out of New York Harbor past any given point is, in principle, a simple matter; for it is obviously equal to the product of four factors, namely, the width of the channel at that point, the average depth, the average velocity of the current, and the duration of flow. The first two factors can be determined very readily from any good chart of the harbor; the last one may be determined with reasonable precision from a series of current observations of moderate length; but the determination of the average velocity is, in a tidal waterway such as New York Harbor, a matter of very considerable difficulty. Without entering into the details of the difficulties involved, mention may be made of the following facts: the velocity of the tidal current at any point changes throughout the day, approximately in accordance with the cosine curve; from day to day the velocity changes as the range of the tide changes; at any point in a waterway the velocity of the current is not uniform from surface to bottom; and, finally, the velocity of the current in any horizontal section varies from the center of the channel to the banks.

The determination of the average velocity of the current corresponding to a mean tide is therefore far from being a simple matter. Furthermore, in a harbor where traffic is as dense as in New York Harbor, the making of current observations is in itself a problem of considerable magnitude. It is therefore not surprising that the values arrived at by different investigators vary somewhat. From observations made in 1885 Henry Mitchell, of the Coast and Geodetic Survey, estimated the volume of water passing through the Narrows as 12,703,616,481 cubic feet on the flood and 13,819,895,144 cubic feet on the ebb, or a net seaward discharge of somewhat more than 1,116,200,000 cubic feet each half day.[12] Based on observations made by the Metropolitan Sewerage Commission of New York between 1907 and 1909, Parsons estimated the flood and ebb volumes through the Narrows as 10,778,800,000 cubic feet and 12,041,200,000 cubic feet respectively, or a net seaward discharge of 1,262,400,000 cubic feet per tidal cycle.[13]

A more comprehensive series of current observations than either of the above investigators had at hand was made jointly by the Army Engineers and the Coast and Geodetic Survey in the summer of 1922. The computations have not yet been completed, but it appears that the above estimates are substantially correct and that in round numbers we may safely take the average volume passing the Narrows on the flood as 11 billion cubic feet per tidal cycle and on the ebb as 12¼ billion cubic feet. During each tidal cycle of 12½ hours there is therefore, on the average, a net seaward movement of 1¼ billion cubic feet through the Narrows, that is a movement at the rate of 2½ billion cubic feet per day. This excess of the ebb volume over the flood is obviously to be ascribed, if not wholly at least in very large part, to the run-off from the territory that drains into New York

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[12] *U. S. Coast and Geodetic Survey Rept. for the Year Ending June, 1886*, Washington, D. C., 1887, p. 36.

[13] Parsons, *op. cit.*, p. 2037.

Harbor. Estimates of the amount of this fresh, or non-tidal, water, based on gaugings of the Mohawk and Hudson Rivers above Troy and on rainfall data for the territory below Troy, give 25,000 or 26,000 cubic feet as the average discharge per second past the Narrows,[14] or, in round numbers, a discharge of about 2¼ billion cubic feet per day.

From the Upper Bay the tide carries 5¾ billion cubic feet into the Hudson during the flood, while during the ebb the Hudson discharges into the bay 6¾ billion cubic feet, the fresh-water run-off being a little in excess of 1 billion cubic feet during a tidal cycle of 12½ hours,[15] or 2 billion cubic feet per day. Through Kill van Kull the flood carries from New York Harbor into Newark Bay 1½ billion cubic feet, and the ebb returns into the harbor very nearly 100 million cubic feet more;[16] so that in a day Newark Bay pays tribute of almost 200 million cubic feet of water to New York Harbor. For the Harlem River, Parsons calculated a net ebb or northerly discharge into the Hudson River of 17½ million cubic feet for a full tidal cycle, or about 35 million cubic feet per day. For the central portion of the Harlem his figures give a movement of about 162½ million cubic feet for the flood and 180 million cubic feet for the ebb.[17] A considerably larger figure for the ebb excess in the Harlem is derived by Robinson from later observations; he gives 44 million cubic feet[18] per tidal cycle as the excess of ebb over flood or nearly 90 million cubic feet per day.

The question of the net resultant discharge of East River has been the subject of considerable discussion. Attention was first directed to the matter by Henry Mitchell[19] who derived, from a short series of observations, a volume of 4455 million cubic feet for the ebb and 4007 million cubic feet for flood,[20] or a net resultant discharge from Long Island into New York Harbor of very nearly 900 million cubic feet per day. This excess of ebb over flood he attributed to the fact that in East River the depth of the water is greater when the current is flowing from Long Island Sound to Upper Bay than when the current is in the reverse direction. This fact is brought out in Figure 9, which shows that the westerly-slope lines are, as a whole, higher than the easterly-slope lines.

To this net resultant discharge from Long Island Sound into Upper Bay a very considerable importance has been attached. To quote Mitchell, "the circulation of the sea by way of the East River, although small in quantity, is the element which determines the superiority of New York Harbor over nearly all the 'sand-barred inlets' of the world. It is this circulation which keeps the port open in winter and sweeps the sand from its threshold."[21] In connection with the disposal of sewage, it was thought that this resultant flow played an important part in flushing out New York Harbor; and recently it has been suggested that the discharge from Long Island Sound be increased by the erection of tidal gates to shut off the return eastward flow through East River.[22]

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[14] *Rept. Metropolitan Sewerage Commission of New York, April 30, 1914*, p. 558.

[15] *Ibid.*, pp. 558 and 562.

[16] *Ibid.*, pp. 558 and 563.

[17] Parsons, *op. cit.*, p. 2051.

[18] *Rept. Metropolitan Sewerage Commission of New York, April 30, 1914*, p. 587.

[19] Henry Mitchell: Circulation of the Sea Through New York Harbor, *Science*, Vol. 9, 1887, pp. 204–205.

[20] *U. S. Coast and Geodetic Survey Rept. for the Year Ending June, 1886*, Washington, D. C., 1887, p. 36.

[21] Mitchell, *op. cit.*, p. 205.

A preponderance of about 400 million cubic feet in the ebb, or about 10 per cent of the tidal flow, was generally accepted until 1908, when at the instance of the Metropolitan Sewerage Commission of New York the Coast and Geodetic Survey investigated the matter anew, the question being turned over to the late R. A. Harris of the Division of Tides. From a mathematical discussion of the flow of water in open channels, in connection with the current observations that had up to that time been made in East River, he arrived at the conclusion that the volume of water flowing westerly was probably not more than one or two per cent greater than the volume flowing easterly.[23] This estimate would therefore make the net resultant discharge not over 100 million cubic feet per tidal cycle. Parsons[24] follows Harris and gives 80 million cubic feet as the net discharge per tidal cycle. But from current observations made by the Corps of Engineers of the U. S. Army in 1910 and 1911, in the vicinity of Hell Gate, Robinson derives figures[25] closely approximating Mitchell's.

From the large quantity of water circulating in the various channels of New York Harbor, an exaggerated notion of the flushing action of the waters in the harbor is frequently entertained. It is to be borne in mind that for the greater portion of the harbor the water that is returned on the flood is not clean sea water, but harbor water which had been carried to a lower portion of the harbor on the preceding ebb. In the section dealing with the distance traveled by a particle during a tidal cycle it was shown that with a current which at strength has a velocity of two knots, a particle will be carried a distance of about 48,000 feet, or eight geographic miles during the period of a single flood or ebb. If, therefore, the flood and ebb velocities were equal, a particle would merely move a given distance downstream on the ebb and return the same distance upstream on the flood. It is the excess of the ebb over the flood that finally carries a particle from the upper reaches of the harbor out past the Narrows and into the sea.

In the circulation of the waters in the harbor it is therefore the excess of the ebb volume over the flood that is the important feature. Two causes contribute to this ebb excess. The first and principal cause is the fresh-water run-off from nearly 15,000 square miles of territory that drains into the Atlantic through New York Harbor, and the second is the excess of the flow coming from Long Island Sound which circulates through the Harlem, Hudson, and East Rivers and thence through the Narrows out to sea.

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[22] S. A. Reeve: Cleansing New York Harbor, *Geogr. Rev.*, Vol. 12, 1922, pp. 420–23.

[23] *Rept. Metropolitan Sewerage Commission of New York, April 30, 1914*, p. 568.

[24] Parsons, *op. cit.*, p. 2041.

[25] *Rept. Metropolitan Sewerage Commission of New York, April 30, 1914*, p. 558.

THE ICE SHEET OF CENTRAL GREENLAND

A REVIEW OF THE WORK OF THE SWISS GREENLAND EXPEDITION*

By Charles F. Brooks
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Our knowledge of the physiography and meteorology of Greenland has been built up by laborious stages chiefly in the past two decades. The earliest information related to the easily accessible west coast where most of the Eskimos and Danish officials and traders live. Then followed the northwest coast, during the middle of the nineteenth century, through the expeditions in search of Sir John Franklin and later from various explorers whose main objective was the North Pole. The forbidding, ice-bound eastern coast was practically unknown until three or four decades ago, and even yet scientific expeditions have given us only reconnaissance reports.

Crossings of Greenland

The great glacier, known as the inland ice, covering some 715,400 of Greenland's 827,275 square miles, has for the most part proved too great a barrier to the explorers' zeal. A. E. Nordenskiöld in 1883 penetrated the interior from the middle of the west coast to a distance of more than 200 kilometers from the edge of the ice, and his Laplanders appear to have gone 100 kilometers farther still. Peary in 1886 traveled nearly 200 kilometers up on to the inland ice in the same region. Nansen in the autumn of 1888 actually crossed the southern ice dome, on a journey of more than 400 kilometers. Peary in 1892 and 1895 and Knud Rasmussen in 1912 and 1917 made long journeys across the northwestern portion of the inland ice. Also Mylius Erichsen in 1907 and Ejnar Mikklesen in 1910 traveled over the border of the inland ice of northeastern Greenland. Central Greenland was practically unknown until de Quervain's summer crossing of 1912 and J. P. Koch's traverse of the widest and highest part of the central ice dome in the spring of 1913 (see Fig. 1).[1]

With at least the preliminary results from all the scientific expeditions at his disposal, and with a wealth of information gained through personal exploration of the coasts, Lauge Koch has just presented a large-scale review of the physiography and geology of Greenland and the broad structural relations of this continental island to North America and northwestern Europe.[2] Excluding a northwestern coastal belt of sedimentary rocks and a northeastern folded mountain chain, the rock surface of Greenland is a northwestward-sloping gneiss plateau to plain. Across it from Disco to Angmagssalik runs a great central depression associated with which are large areas of basalt. The depression is seen in the coast profiles, which here drop to sea level or near it from elevations of nearly 2000 meters to north and south, and also in the topography of the inland ice. The most productive glaciers form at the ends of the depression, for into it tends to converge ice from the two centers of glaciation which it separates. This situation adds greatly to the significance of the detailed glacial studies prosecuted by the Swiss expedition in this region, and to de Quervain's observations during his crossing, along the course of the depression.

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* Alfred de Quervain, P. L. Mercanton, and others. Ergebnisse der Schweizerischen Grönlandexpedition, 1912–1913, xx and 402 pp.; maps, diagrs., ills. *Denkschr. Schweizerischen Naturforschenden Gesell.*, Vol. 53, Zurich, 1920.

[1] Cf. The Recent Crossings of Greenland, *Geogr. Journ.*, Vol. 42, 1913, pp. 545–550; CaptainKoch's Crossing of Greenland, *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, pp. 356–360.

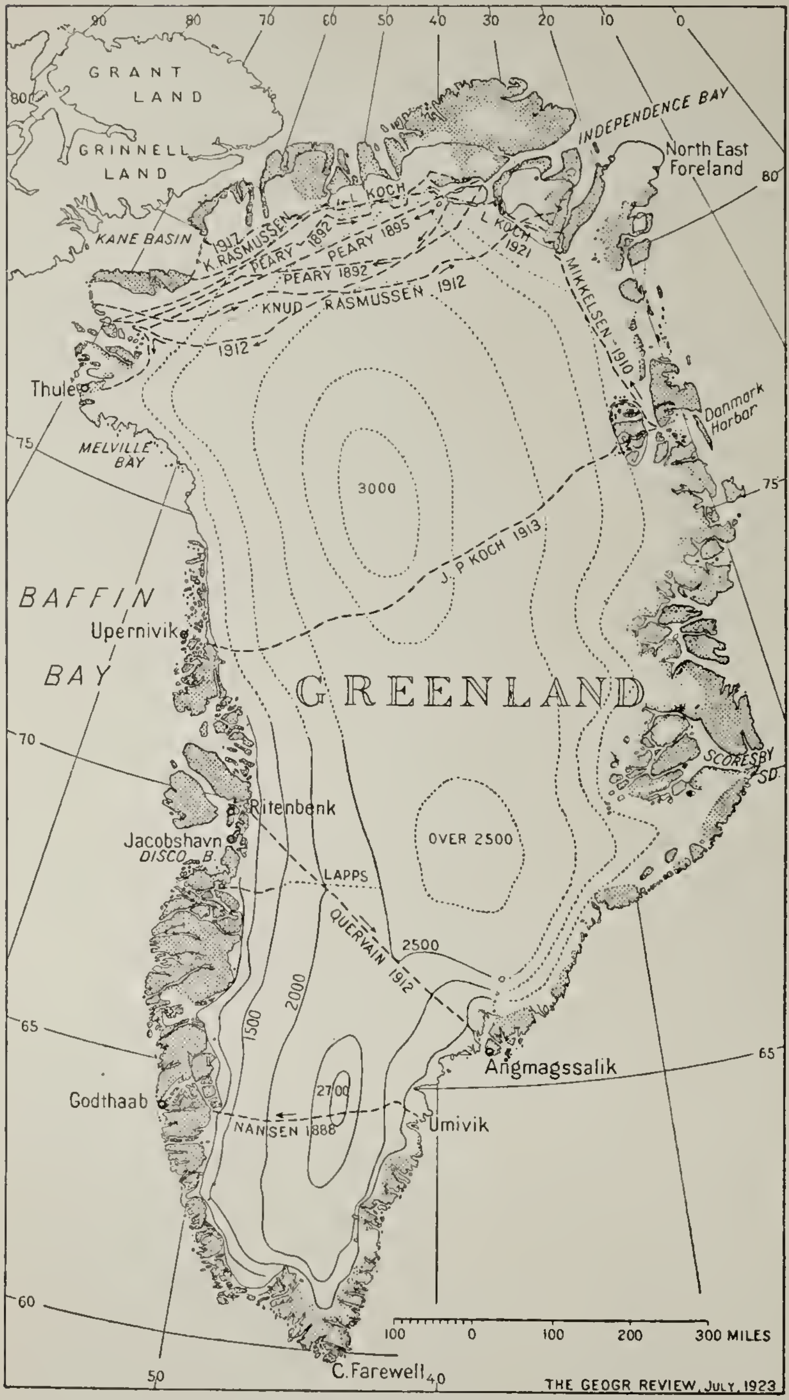

Fig. 1—Map of Greenland, showing the general topography of the inland ice. After Fig. 1, Pl. II, in de Quervain's report. The routes of explorers crossing the ice sheet are also shown. Scale of map approximately 1:2,100,000.

Organization of de Quervain's Expedition

Dr. Alfred de Quervain had been so impressed with observations made during a short trip over the inland ice in 1909 that he organized an expedition for further study. One party, headed by de Quervain, crossed the inland ice from near Jakobshavn to Angmagssalik (see map). Another party, led by Dr. P. L. Mercanton, the Swiss glaciologist, spent the summer studying glacial phenomena and observing the weather on the western border of the ice sheet; and two members of his group, Dr. W. Jost and Dr. A. Stolberg, wintered in 1912–1913 at Godhavn to make aerological observations amplifying those of 1909. An eastern party, led by Dr. H. Hoessly, was established in the fall of 1911 to make anthropological studies of the Eskimos[3] and observe the weather till joined by the crossing party. A popular account of the expedition, "Quer durchs Grönlandeis" by A. de Quervain, was published in 1914. The full meteorological and glaciological results could not be published till after the international polar synoptic weather charts for 1912–1913 were issued, in 1916.

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[2] Lauge Koch: Some New Features in the Physiography and Geology of Greenland, *Journ. of Geol.*, Vol. 31, 1923, pp. 42–65. Koch (who accompanied Rasmussen in 1917) made a successful crossing in 1921. See *Geogr. Tidskrift*, Vol. 26, 1922, pp. 182–187.

The Crossing

Well-laid plans prevented the suffering which sometimes befalls a polar explorer. Setting out from Jakobshavn the crossing party arrived on June 20 at the edge of the inland ice, at an altitude of nearly 600 meters. The way over the marginal belt of the ice sheet was difficult. The usual down-slope, brisk, southeast wind was faced. The ice was partly snow-covered and irregular and treacherous. During the first few days many ice swamps were encountered, and in one instance the party plunged through the ice into water 3 meters deep. There were a number of depressions 30 to 40 meters deep. Crevasses, in which annual (?) layers of ice 0.1 to 1.5 meters thick were visible, locally broke the surface to a distance of more than 100 kilometers along the route. Beyond this point the explorers got out of the zone of melting whence better progress was made on the smoother, firmer surface. The mountains on the west and the large cumulus clouds over the heated bare zone were now lost below the horizon, and for a fortnight only the smooth, undulating snow surface was seen and the clouds above, projected against a sky milky with the dust from Katmai. Occasionally, with a change of wind to an up-slope direction, snow fell. The crest was reached July 13 at 2500 meters after a march of 420 kilometers. On the down grade sails were set at times to a good, following wind, and rapid progress was made. The temperature rose above freezing again, and the snow became too soft for daytime travel. Once a few raindrops fell. To the east a previously unknown mountain region rose over the horizon. The highest peak (about 3400 meters, or 11,000 feet) was named Mt. Forel. It may overtop Petermann Peak, heretofore thought to be Greenland's highest mountain.[4] Descending rapidly to sea level the party left the inland ice on July 21 and soon, with aid from the eastern party, crossed to Angmagssalik. A little rain on July 21 and a gale (föhn) off the inland ice with a temperature up to 61° F. added interest to the close of the successful crossing.

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[3] The first part of these studies, on the Eskimos of East Greenland, by H. Hoessly, was published in 1916.

[4] Lauge Koch, *op. cit.*, p. 45, designates Mt. Forel as "one of the highest peaks of Greenland . . . 2760 meters . . ."; but he does not give any reason for discounting de Quervain's observation of 3440±52m., nor does he say how or by whom the altitude he gives was obtained.

Topography of the Ice Sheet

A contour map was constructed for a strip 40 kilometers wide along the whole route. The actual altitude profile of the inland ice shows but little deviation from an ideal, smooth curve. The departures in form are explicable on the basis of the known topography on both sides and the probable surface form of the underlying rock. Some of the irregularities may be ascribed, however, to secondary features resulting from uneven melting and drainage in the border zone.

The form of the surface in the marginal zones was in general one of broad terraces many of which contained lakes a kilometer wide and two or three kilometers long. On the western slope in the first 150 kilometers there were about 10 terraces, and in the next 100 kilometers along the route there was a broad plain followed by four more steps. The steps of the eastern slope were similar to those of the west, but were steeper and without meltwater lakes. The central portion, extending 200 kilometers from an altitude of 2200 meters on the west to 2300 meters on the east, sloped gently from the divide. Its even surface was ruffled only by small snow dunes 2 to 15 centimeters high. The great fiord system of the west coast evidently extends more than 100 kilometers inland under the ice, as is shown by the surface form. The thickness of the ice is not known; over peaks it may be only a few hundred meters.

Summer Weather on the Ice Sheet

In the zones of melting the temperatures averaged just below freezing, and the range was generally small. The midday temperature was kept down by the insatiable heat requirements of the melting snow and ice and at midnight was held fairly steady by the large yield of latent heat from the freezing surface. In the central zone of no melting, however, the temperatures averaged only 14° F.; and the range was great, the extremes being −7° F. and 25° F. This cold air is the source of the characteristic down-slope wind.[5] At times this wind, usually moderate in strength, increased to storm force and at others weakened or even reversed under the influence of changes in the general pressure gradients. A strong gradient across Greenland resulted in föhn conditions, with snow on the up-slope and a warm, dry wind on the down-slope. Important though these föhn winds are, both in bringing snowfall and even rain to the ice sheet and in melting its margins, they are foreign to the prevailing quiet steadiness of the weather.

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[5] The prevalence of down-slope winds, even in midsummer, is strikingly in accordance with Hobbs' theory of the glacial anticyclone. See review in *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, p. 963.

Summer Weather Along the West Coast and Ice Front

The weather of the bare coastal zone on the west is closely related to that of the inland ice. The general meteorological situation over the bare coastal zone in summer is about the reverse of that over the ice cap. The bare zone is much heated by the sun and thus is a warm belt between the cold of the inland ice on the one side and the cold of the iceberg-dotted water (Davis Strait) on the other. On account of the expansion and lateral overflow of the heated air, pressure gradients are established toward the warm zone, resulting in a daily sea breeze on the western portion and a daytime intensification of the fall wind off the ice, with rising air between. This circulation gives the coasts chilly, cloudy weather and causes some daytime cloudiness over the bare zone.

Alimentation of the Ice Sheet

Three zones of ice and snow were found on the ice sheet: (1) a border zone where the abundant melt water had so penetrated the snow as to prevent any identification of annual layers by differences in density, (2) an intermediate zone where summer melting formed a hard crust on top of the annual accumulation of snow, and (3) a far interior zone where there was no summer melting to mark the annual layers. The outer zone includes not only the belt in which the snow of winter melts completely during the summer but also a strip in which such summer melting is not complete. The usual limit of complete melting is called the snow line. The expedition crossed Greenland before the end of the melting season, and snow was found on all parts of the ice sheet, hence the snow line could be located only through indirect observations. One clue was the inward extent of melt-water lakes. These were found to a distance of 107 kilometers along the route (about 90 kilometers from the edge directly down the slope), up to an elevation of 1530 meters. It is a fair presumption that such lakes could not form on a snow foundation and, therefore, that they must mark the zone where ice from the interior is melting. From observation of the size of the ice granules, which are large in glacial ice, small in new *névé*, it was deduced that the perennial snow line was not less than 80 nor more than 120 kilometers along the crossing route from the western margin of the inland ice. These two lines of evidence reinforce each other in indicating a snow line on the western side of about 1450–1500 meters altitude and 100 kilometers inward on the route, or 80 kilometers directly in from the margin. The other portion of the outer zone of considerable melting extended to 50 kilometers farther inland, where the altitude was 1800 meters. Here it became possible to distinguish the annual accumulation. On the western slope at 8 stations between 1831 and 2300 meters the average water equivalent was found to be 36.2 centimeters, the successive values being 35.0, 33.5, 26.5, (25), 34.2, 54.5, 44.0, and 39.5. On the eastern slope corresponding determinations were made at 6 stations from 1236 to 2258 meters. These averaged 33.6 centimeters of water content, and the individual values from lower to higher stations were 39.2, 35.3, 34.0, 33.6, 33.6, and 26.1. The higher values at lower elevations on the eastern side are a result of the much heavier snowfall here (compare 114 centimeters precipitation at Angmagssalik with 22.4 centimeters at Jakobshavn from July, 1911, to June, 1912). On the east the snow line is depressed to 1100 or 1000 meters above sea level. If the trends of the snow accumulation on both slopes are projected to the crest the amount there might reasonably be taken as between 25 and 30 centimeters. De Quervain takes 35 centimeters as a reasonable figure to represent the annual (water) increment in the interior of the inland ice (zones 2 and 3).

To obtain the probable precipitation for the year ending June 30, 1912, the 5.5 centimeters computed evaporation must be added, making 40.5 centimeters. As the precipitation at Jakobshavn, on the west, for these 12 months was 11 per cent below the average, while that at Angmagssalik, on the east, was 14 per cent above the average, it seems fair to assume that the precipitation of the interior for this year represents about average conditions. Current maps of the precipitation of Greenland evidently need revision, for this is much more than our maps show.[6]

The height of the snow line on the western slope, 1450–1500 meters, is even higher than that on glaciers on the northern slope of the Alps, 22° of latitude nearer the equator. The snow line in the interior is higher than on the coast at Disco Island (1000 m.) or near Angmagssalik (not higher than 1100–1000 m.). The nearer the pole the less does altitude control the snow line, and the more does the exposure affect it. The decreasing precipitation toward the interior, the greater brightness of the sun on föhn days, and the general anticyclonic weather are the important factors in the high snow line of inner Greenland.

Movement and Ablation of the Ice Front

The sunlight, the temperature, and the wind together melted the ice front back about as fast as the ice moved forward. The rate of movement of the ice was small in the summer of 1912. It was not even 6 centimeters a day at the most rapid point, 1.3 kilometers from the front, and less than three-quarters of a centimeter at the moraine crest (a greater movement was shown by individual tongues where the slope was steep). From the ablation of 1.25 meters at 625 and 650 meters, and 1.00 meter at 675 meters, in 39 days, a total summer loss on this front was taken to be 2.3 meters. This corresponds closely to Drygalski's figure, 2 meters. Melting was very rapid under föhn conditions, as June 29–July 1, when föhn and rain took off 19 centimeters of ice.

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[6] As a rough approximation based on de Quervain's observations and some observations cited by reviewers of his work (Brückner, *Zeitschr. für Gletscherkunde*, Vol. 12, 1922, pp. 152–153; de Martonne, *Ann. de Géogr.*, Vol. 32, 1923, p. 82) the following may be presented as a closer approach to the truth than the indications of current maps: The 100-cm., or 40-inch, line should run from Angmagssalik (100 cm. average precipitation) to a little north of Ivigtut (120 cm.); the 50-cm., or 20-inch, line should reach from the east coast north of Angmagssalik, perhaps at latitude 70°, to the west coast just north of Godthaab (65 cm.); the 25-cm., or 10-inch, line from about Franz Joseph Fiord to Jakobshavn (25 cm.) and thence north of Disco; and the 12.5-cm., or 5-inch, line could loop south from Danmarkshavn across the center of Greenland at latitude 73° to the west coast at Cape Alexander.

Present Condition of the Ice Sheet in South Central Greenland

Is the Greenlandic ice sheet a relic of the glacial period, or is the present snowfall on it sufficient to prevent melting and evaporation from reducing it from year to year? Comparison of the rate at which ice is lost at the edge of the sheet with the rate of accumulation in the interior provides some basis for a quantitative answer to this question. Data are taken for the western section. The western accumulator extends from the snow line, 80 kilometers from the edge of the ice, to a line somewhere beyond the crest. Nansen and de Quervain agree that the highest land under the ice in this part of Greenland is near the east coast, and de Quervain in Figure 2 has presented his idea of the rock foundation under the route on which he crossed. It is quite evident that most of the ice from 20 or even 30 kilometers east of the crest must go west. The annual addition of ice on the accumulator must be computed for three belts: (1) the outermost, between the snow line and 1831 meters; (2) the zone between the stations at 1831 and 2399 meters in which measurements of the annual addition could be made; and (3) the upper zone in which there was no direct way of determining the annual addition. For the second zone observations indicate a total of about 36 centimeters water content of ice added annually. For the outer zone the addition must vary between 0 at the snow line and 35 centimeters as observed at 1831 meters—say an average of 18 centimeters. For the upper zone, we may take 40 for the western edge and 25 for the eastern, or about 33 for the average. The widths of these zones along the route are approximately 60, 180, and 90 or 100, or roughly as 2, 6, and 3. The weighted average for the whole accumulator, 330 or 340 kilometers along the route, or actually 270 kilometers broad, is 32 centimeters water, or nearly 36 centimeters ice. As this accumulation is dissipated in the outer zone only 80 kilometers wide, the average loss from the dissipator must be 36 x 270/80, or 121 centimeters to balance.[7]

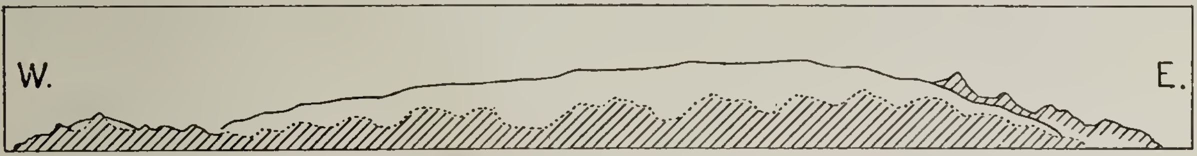

Fig. 2—Schematic representation of the relation of the inland ice to the west and east coasts, from latitude 70° on the west to latitude 66° on the east. After de Quervain, p. 66.

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[7] De Quervain used 40 cm. as the addition of ice on the accumulator, for he did not allow for the reduced addition on the margin and at the summit. Also he used 330 km. as his traverse of the western portion of the accumulator. Brückner in his review (*loc. cit.*, p. 155) corrects this to 320; also, not understanding that the 40 cm. stood for ice, he would have used 35 and obtained 112 cm. in his computation. Mercanton takes 440 km. as the total distance to the summit of the ice sheet. It so happens that my figure of 335 km. for the party's traverse of the western accumulator lies between de Quervain's and Mercanton's, although I added on 25 km. on the eastern slope, which they did not plan to include.

As mentioned earlier, the annual ablation at the margin of the ice sheet is set at 2 meters by Drygalski and 2.3 meters by Mercanton. Assuming that the rate of ablation is directly proportional to the altitude and that it becomes 0 at the snow line, the average ablation is 83 or 95 centimeters over the dissipator.[8] If 36 centimeters is taken as the addition of ice to the accumulator, and 95 centimeters as the ablation from the dissipator, and if the glacier is supposed to be in equilibrium the snow line should be at 36 x 270/95, or 102 kilometers from the western margin instead of at 80 kilometers as observed.[9] De Quervain ascribed the discrepancy between the larger accumulation and the smaller ablation to the amount of ice carried away in icebergs, estimated at 10 to 100 cubic kilometers per year from the whole west coast. These amounts run up to 25 per cent of the amount lost by ablation. But for the portion of the glacier considered there is practically no loss in the form of icebergs. Some tongues, however, descend to lower elevations where the melting is faster, a rate nearly twice that at 650 meters having been observed at 360 meters altitude. In any event, the observed accumulation of ice was greater than the observed dissipation, which would seem to indicate that the glacier is decidedly not a relic but is fully maintaining itself in its present extent.

We may also ask whether such a glacier could start under present general climatic and topographic conditions. It does not seem likely that the ice could have started forming in the interior, for the snowfall on an upland so far from the coast would be insufficient to survive the summer melting. The eastern mountains, however, rise well above the snow line. These may have been responsible for the first accumulations of ice, till the sheet grew to a height where it became its own accumulator and continued to rise till the elevation in the interior exceeded that on the mountains nearer the coast. In this it corresponds to the northwestern European ice sheet, the summit of which was to the east (inland) of the crest of the Scandinavian highlands, and also to that of Labrador where the summit was west (inland) of the highest land. The ice sheet of Greenland could not be built up under present conditions without the aid of the changes which the rising accumulation of ice on the eastern mountains would bring about. The ice plateau now divides the polar circulation markedly. Without it the subpolar cyclones would cross Greenland much more commonly than at present, with consequent higher temperatures and heavier precipitation. De Quervain believes that the influence of the heavier precipitation would preponderate over that of the higher temperature and result in the formation of a new ice sheet. Under present conditions the ice sheet seems to be stable. If it should be built up higher it would favor a stronger outward circulation and be more effective in preventing ingress of cyclonic, snow-bearing winds.

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[8] This average is less than the arithmetical mean of 2 and 0 or 2.3 and 0, or 1.0 and 1.15 m. taken by de Quervain, for about ⅔ of the increase in altitude comes in the first half of the distance.

[9] Mercanton goes through this computation on an erroneous assumption of 2.3 m. as the ablation over the entire dissipator and arrives at the impossible figure of 65 km. as the distance of the snow line inward along the route (p. 271).

This would reduce its sustenance and thus bring about a state of equilibrium. Where Nansen crossed, farther south, the slopes were steeper and the interior higher, owing probably to the heavier snowfall as well as to the generally greater altitude of the land in the south. There seems to be another highland and heavy-snowfall ice dome just north of the eastern mountain region discovered by de Quervain and named by him Switzerland. The central ice dome of Greenland appears to be but little higher (Koch's and Wegener's maximum was just over 3000 meters) even though the land is much wider.[10] Northward and toward the interior the snowfall must greatly decrease, apparently to only 30 centimeters at the summit of Koch's crossing. If the density of this snow were about the same as that found near the crest of de Quervain's route, namely 0.44, the water equivalent of the 30 centimeters would be only about 13 centimeters, or less than half that on the crest farther south. Further exploration is called for, particularly in the region between Sermilik Fiord and Scoresby Sound (latitude 70° N.) where the mountains and the inland ice rise well above the snow line.

Discussion of other portions of the report must be left for reviews in more specialized journals.[11] The observations made along the front of the inland ice will be found of exceptional interest to the physiographer, as showing the conditions which may have obtained on the glacial fronts of America and Europe not many thousand years ago. So, also, the painstaking aerological observations made at Godhavn during the Arctic winter, and their comparison with similar free-air observations made in northeastern Greenland, Iceland, and Spitzbergen at the same time, will interest the meteorologist as definitely disproving the existence of a general circumpolar whirl in the Arctic.

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[10] Lauge Koch, *op. cit.*, and de Quervain do not agree as to the probable locations and extents of the ice domes of central Greenland. Koch places the Switzerland dome very near the mountains and the coast and greatly restricts its size, and he indicates the central dome to the south of J. P. Koch's crossing instead of to the north as de Quervain has it. Since L. Koch's map (his Fig. 4) does not correspond to the observations de Quervain made along the route he traversed, the reviewer is inclined to favor de Quervain's map (see Fig. 1).

[11] Further details of the physiography will be discussed by the present reviewer in a forthcoming number of the *Journal of Geology* and of the meteorological results in the *Monthly Weather Review.*

SOME RECENT TOPOGRAPHIC MAPS OF THE COASTAL PLAIN OF GEORGIA AND FLORIDA

By Roland M. Harper

Geological Survey of Alabama

Eight or ten years ago the only published government topographic maps of any considerable part of the coastal plain of the United States between Maryland, which was completely mapped, and the Mississippi River were parts of two United States Geological Survey sheets extending from Maryland across the Potomac River into Virginia, one around Norfolk, several contiguous ones in eastern North Carolina, parts of one 30-minute and of two 15-minute quadrangles along the fall line near Milledgeville and Columbus, Ga., several contiguous sheets in the hard-rock phosphate region of Florida, and a few scattered areas in Mississippi and Louisiana. This dearth of detailed topographic information is doubtless largely responsible for the treatment of the very diversified coastal plain as a unit by nearly all northern physiographers who have had occasion to discuss it.

The World War made additional maps of the country near the Atlantic coast very desirable, and on March 26, 1917, Congress made a special appropriation for topographic mapping, to be done jointly by the United States Geological Survey and the War Department. Work was prosecuted actively for the next few years, with the result that Delaware and the coastal plain of Virginia are now completely mapped (except for the two Eastern Shore counties of Virginia), together with large areas in southern South Carolina and eastern Georgia and a few sheets in the northeastern corner of Florida. Now that the topographic work in these states has halted again, at least temporarily, it will be appropriate to review the results as far as they relate to Georgia and Florida.

The new maps are all 15-minute quadrangles with a scale of 1:62,500, or nearly a mile to the inch. Most of those in the Eocene red hills and northward have a contour interval of 20 feet, and those farther south 10 feet. All or nearly all can be had with green overprint showing woodland (in a few cases making a distinction between forest and brush, as is done more commonly in the West).[1]

Maps of Georgia

The maps for the coastal plain of Georgia make a continuous strip two sheets wide between the meridians of 81° 30′ and 82° W. from the fall line to the St. Mary's River at the southern border of the state, except that one sheet just east of Jesup is lacking. Farther east there are four or five sheets between 81° 15′ and 81° 30′, the two northernmost being partly in South Carolina and the next nearly all in Effingham County; then comes a gap of a degree and a quarter of latitude between that and the Cumberland Island sheet near the southeastern corner of the state. The lack of topographic maps between Cumberland Island and Savannah is, however, largely compensated by the Coast Survey charts, which have been in existence for many years, and by government soil maps of Chatham and Glynn Counties. West of longitude 82° there are four more sheets north of latitude 33° and east of longitude 82° 30′, connecting with the sheets in the Piedmont region which were published long ago, and three south of latitude 31° and west of longitude 82°; the Milledgeville sheet (published in 1912, before any adjacent areas) partly in the Piedmont and partly in the coastal plain; the Irwinton sheet (surveyed before the war and published in 1920) immediately south of it; the southeastern corner of the Talbotton sheet (published in 1907, with a scale of 1:125,000); and the Columbus sheet (published in 1908) just south of the western half of the last.

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[1] The use of 15-minute quadrangles (with a scale of 1 : 62,500) for such level and thinly settled country as most of Florida gives more detail than is really needed at present and makes a set of maps for a given area or trip just four times as bulky and expensive as the usual 30-minute quadrangles would be. The green overprint for woodland, although useful to botanists and others in regions that are mostly under cultivation, is almost superfluous in Florida, where it covers nearly the whole map and obscures the other features.

These maps cover parts of several different natural regions which the writer and others had long ago distinguished in reconnaissance work, and in some cases they make it possible to locate the regional boundaries more accurately than has been done heretofore.[2]

Parts of the fall-line sand-hill belt are shown on the Hephzibah, Harlem, Milledgeville, and Talbotton sheets, which ought to dispel the impression given by some current geographical texts that the fall line is a seaward-facing scarp or terrace. The sand hills are not noticeably lower than the adjacent Piedmont region. They are, for instance, about 400 feet above sea level a few miles west of Augusta and 700 feet south of Talbotton. The topography is so similar that it would be almost impossible to trace the fall line across Georgia by these maps alone. The important difference between the two regions is in the soil, one having mostly residual red clay and the other loose whitish sand.

The Cretaceous or blue marl region of western Georgia occupies most of the Columbus sheet. It is a topographically mature region, with some of the valleys wider than the ridges, and very little swamp.

The Eocene red hills are represented by the Irwinton, Stapleton, Gough, and Green's Cut sheets and small parts of a few others, all with 20-foot contours except the Gough, which has 10-foot contours. On comparing one of these sheets with one for the Piedmont (most of which have 50-foot contours and half the scale) no great difference is noticed except that the coastal-plain areas are a little more swampy; but if the same scale and contour intervals were used for both regions the smaller local relief in the coastal plain would be evident. Some state maps, including the latest United States Geological Survey base map, show a considerable body of water in the northern part of Wilkinson County called Black Lake; but the Irwinton sheet shows it to be nothing but a bayou or old channel at the edge of the Oconee River swamp, hardly worth mentioning on a state map.

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[2] For a recent regional map of Georgia see *Geogr. Rev.*, Vol. 10, 1920, p. 342.

The lime-sink region presumably crosses the Millen and Hilltonia (Hiltonia?) sheets (which have 10-foot contours); but it is much less distinct topographically and otherwise in eastern than in western Georgia, and in South Carolina it can be distinguished with difficulty if at all. Similarly the Altamaha Grit escarpment, which rises about 150 feet above the lime-sink region in some places in southwestern Georgia, is hardly noticeable east of longitude 82°, the area for which we have maps.

The Altamaha Grit or rolling wire-grass country is well displayed for the first time on the Rocky Ford, Oliver, Statesboro, Brooklet, and Claxton sheets. Its topography is quite different from that of adjacent regions and was characterized by Otto Veatch[3] as "unlike that of any other coastal-plain formation"; but it is merely a submaturely dissected region with occasional undissected uplands dotted with shallow ponds (less frequent in the area mapped than farther west), which may or may not be due to the dissolving out of limestone which lies buried beneath several hundred feet of non-calcareous sands and clays. A large part of the difference in appearance between the Altamaha Grit region and other hilly parts of the coastal plain, or the Piedmont, is—or was—due to the vegetation, which is typically park-like—open pine forests on uplands and dense bushy swamps in lowlands. But the farmers are rapidly clearing away the forests—the improved land having increased from about 13 per cent in 1900, when the writer first visited the region, to 32 per cent in 1920—so that the difference must be sought more and more in the soil, which is not easily changed. In the southwestern quarter of the Claxton sheet, in Evans and Tattnall Counties, is an undissected flat upland several square miles in extent and about 190 feet above sea level, dotted with shallow cypress ponds.[4]

Toward the coast the rolling wire-grass country passes, sometimes gradually and sometimes rather abruptly, into the flat pine lands. The transition, corresponding approximately with the 100-foot contour north of the Altamaha River, is well shown on the Brooklet and Glennville sheets and not quite so well on the Claxton sheet. The drop from rolling to flat country in southeastern Georgia was noticed by William Bartram[5] about the time of the Revolution and is regarded by Veatch as a marine terrace.[6] But the explanation is not so simple, for in northern Florida the same flat pine region is higher than the hammock belt immediately west of it. The soil is much the same in the flat as in the rolling country, sandy loams prevailing in both.

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[3] Otto Veatch: Altamaha Formation of the Coastal Plain of Georgia, *Science*, Vol. 27 (N. S.), 1908, pp. 71–74; reference on p. 71.

[4] R. M. Harper: A Phytogeographical Sketch of the Altamaha Grit Region of the Coastal Plain of Georgia, *Annals New York Acad. of Sci.*, Vol. 17, 1906–07, pp. 1–414; reference on p. 24.

[5] William Bartram: Travels Through North and South Carolina, Georgia, East and West Florida, the Cherokee Country, the Extensive Territories of the Muscogulges, or Creek Confederacy, and the Country of the Chactaws, Philadelphia, 1st edit., 1791, pp. 28 and 32.

[6] Otto Veatch: The Geology of the Coastal Plain of Georgia, *Geol. Survey of Georgia Bull. 26*, Atlanta, 1911, pp. 25–57; reference on pp. 35–36.

The sheets from latitude 32° to the Florida line cover a pretty flat country, mostly less than 100 feet above sea level, with large areas of swamp but diversified by a few interesting features. Foremost of these is Trail Ridge, which begins a few miles west of Jesup, passes southward parallel to the coast through the unmapped area west of longitude 82° for fifteen or twenty miles and then through the middle of the Folkston, Moniac, and Macclenny sheets and on into Florida (Fig. 1). This ridge has been commented on by several writers[7] but never yet satisfactorily explained. Except where the Satilla and St. Mary's Rivers cut through it the crest of Trail Ridge ranges from about 130 to 175 feet above sea level in Georgia and over 200 feet in Florida, its eastern base from about 60 to 100 feet, and its western base from about 120 to 130. Its northern extremity seems to be south of the Altamaha River, just off the area covered by the present topographic maps, but if it continued a little farther in the same direction it would merge into the low scarp at the coastward edge of the Altamaha Grit region already mentioned. At its southern extremity in Florida it runs into another regional boundary, the western edge of the peninsular lake region. Most of the way across the Folkston and Moniac sheets Okefinokee Swamp touches the western base of the ridge, as if dammed up by it. These two sheets show approximately the eastern third of the swamp, and by means of the green overprint the wooded portions are plainly distinguished from the marshy "prairies."

On the Hinesville sheet there is a low scarp parallel to the coast, with a descent of about 50 feet in a mile, corresponding with the boundary between the Okefinokee and Satilla terraces of Veatch and, at this point at least, with the inner edge of the coast strip, which is characterized by more or less clayey and marly soil contrasting with the prevailing sand farther inland. On the northeast and south of the Hinesville sheet this scarp runs off into areas not yet mapped, but it may be connected with a similar scarp which runs along the western edge of Glynn County and thence southward into Florida. (See the Everett City, Nahunta, and Boulogne sheets.) The old road from Savannah to Florida, traveled by Bartram and other eighteenth-century explorers, follows this low sandy elevation for miles. In Camden County it is a ridge rather than a terrace scarp, and the Satilla River runs parallel to it for about twenty miles before breaking through.

The Cumberland Island sheet takes in nearly the whole of the island for which it is named, which differs from all other islands on the Atlantic coast south of New York, as far as known, in its elevation—over 40 feet in places—and in appearing to be a cut-off part of the mainland rather than a barrier beach built up by wind and waves. It differs further from the other islands in being the home of long-leaf pine, blackjack oak, and a species of the rodent genus *Geomys*.[8]

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[7] For references to earlier literature see R. M. Harper: Geography and Vegetation of Northern Florida, *Sixth Ann. Rept. Florida Geol. Survey*, Tallahassee, 1914, pp. 163–437; reference on p. 329; *idem:* Georgia Coastal Plain Geology and Physiography, *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, pp. 920–923; reference on p. 923.

MAPS OF FLORIDA

For Florida previous to the World War there were only seven topographic sheets, all 15-minute quadrangles with 10-foot contours, surveyed about thirty years ago, soon after the discovery of phosphate. These cover a considerable part of the peninsular lime-sink or hard-rock phosphate region, in the vicinity of Gainesville, Ocala, and Inverness, and small parts of neighboring regions.[9] Work had been begun before the war on some areas a little farther east, and the Palatka and Interlachen sheets (latitude 29° 30′—29° 45′, longitude 81° 30′—82°) were published in 1915 and 1916. The war-time activity resulted in the mapping of the whole northeastern corner of the state, north of latitude 30° and east of longitude 82° 15′, fourteen sheets, including some partly in Georgia which have been noted above. All of these sheets have the same scale and the same contour interval as the older ones.

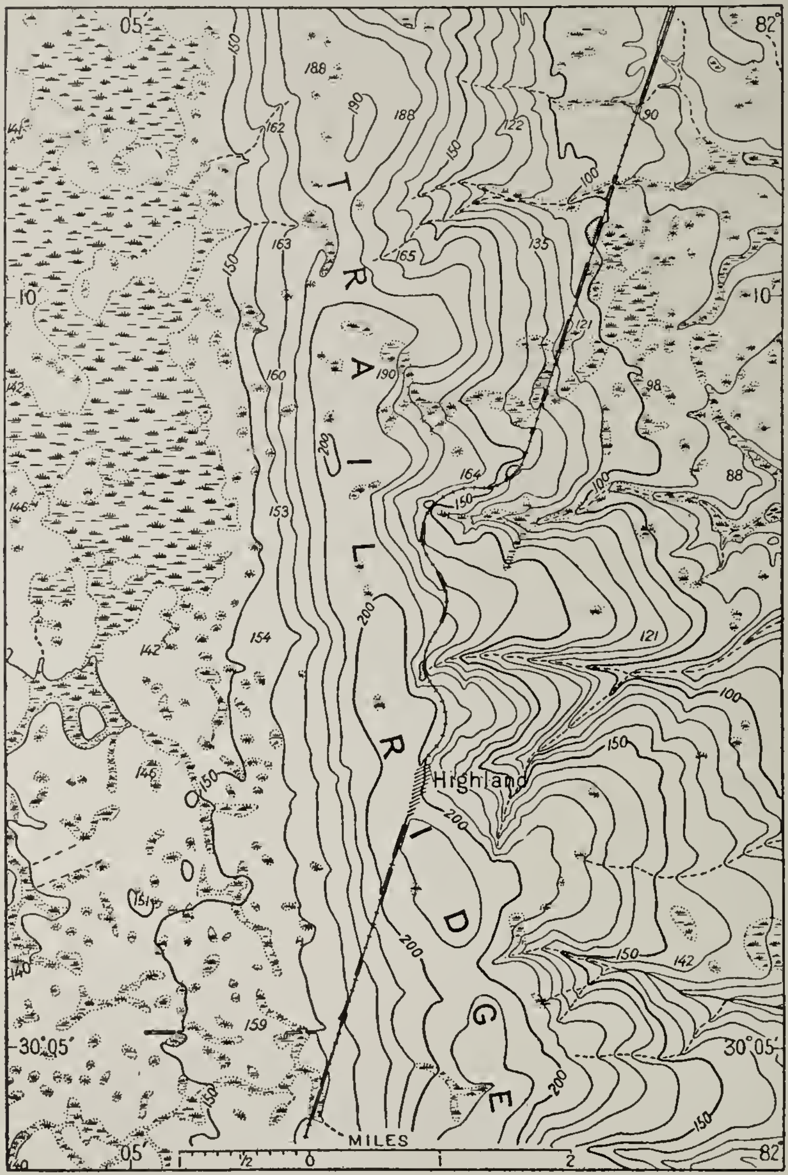

FIG. 1—A part of the Trail Ridge illustrating characteristic topography. Redrawn from the Lawtey quadrangle (Florida). Scale 1:125,000.

Of the new maps the three westernmost show typical portions of Trail

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[8] R. M. Harper: Notes on the Distribution of the Southeastern Salamanders (*Geomys Tuza* and Allies), *Science*, Vol. 35 (N. S.), 1912, pp. 115–119; reference on p. 117.

[9] For a preliminary regional map of Florida see R. M. Harper: Preliminary Report on the Peat Deposits of Florida, *Third Ann. Rept. Florida Geol. Survey*, Tallahassee, 1910, pp. 197–375 (map on Pl. 16, facing p. 204). An adaptation of this map on a smaller scale, with some revisions based on subsequent explorations, was published in the *Geogr. Rev.*, Vol. 2, 1916, p. 362. The original map was copied pretty closely by Soper and Osbon in *U. S. Geol. Survey Bull. 728*, Washington, D. C., 1922 (Pl. 18, facing p. 200), but some of the regional names were needlessly altered there, and no use was made of the work of the writer in the 6th and 13th annual reports where important changes were made in the mapping of northern and central Florida.

Ridge; but its highest point, about 250 feet above sea level, is in an area not yet mapped, a little farther south, near the northern end of the lake region. On the Lawtey sheet a railroad which is otherwise straight for many miles through the flatwoods on either side had to make several curves in ascending the eastern slope of the ridge near Highland (Fig. 1).

Immediately east of these are the Hilliard, Cambon, and Middleburg sheets, all typical flatwoods country, with the larger streams in valleys as much as 50 feet deep in places, and innumerable shallow swamps, cypress ponds, or "bays" on the undissected uplands 70 to 100 feet above sea level and 25 or 30 miles from the coast. The low ridge or terrace mentioned above as running parallel to the coast in Georgia is barely recognizable near Marietta on the Cambon sheet. The soil of the flatwoods is mostly so damp and sour that very little of it is cultivated yet, and the green overprint for woodland covers at least 95 per cent of the area of these sheets.

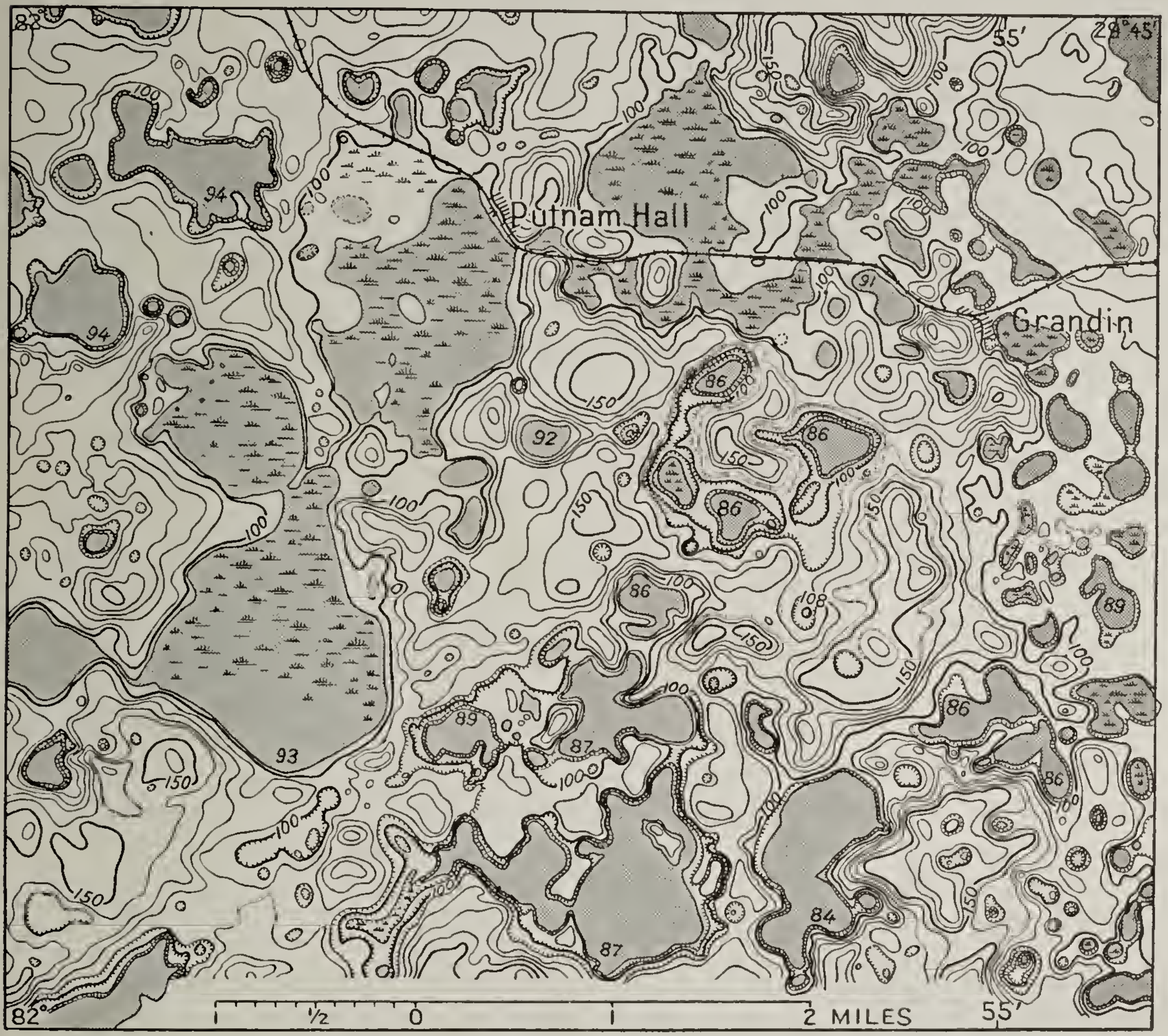

FIG. 2—A part of the Florida lakes region illustrating characteristic topography. Redrawn from the Interlachen quadrangle (Florida). Scale approximately 1:80,000.

On the next three sheets on the east the flatwoods are interrupted by the St. John's River, here an estuary one to two miles wide, and the tidal marshes of a few smaller streams north of it. The three easternmost sheets show the usual features of a low sandy coast, a nearly straight strip of beach and dune, with salt marshes back of it, both beach and marsh being rather narrow in this latitude.

The Palatka and Interlachen sheets, separated from those just mentioned by an unmapped east-and-west strip 15 minutes wide, are the only ones thus far that show any of the beautiful lake region of peninsular Florida, except that the old Citra and Ocala sheets barely touch its ill-defined western edge. The lake region includes the greater part of the Interlachen sheet (Fig. 2) and the highlands in the southern part of the Palatka sheet. In former years, when the lake region was not so well understood as now, the old topographic maps of the lime-sink region farther west were thought to be representative of it.[10] The differences between the two regions as far as surface configuration is concerned are not very marked; but the lake region has many more bodies of water, and their level fluctuates much less with the seasons than it does in the lime-sink region.[11] The abundance of lakes in parts of the lake region not yet covered by topographic maps can be seen on the soil maps of Putnam and Orange Counties, published by the United States Bureau of Soils in 1916 and 1922 respectively. The southern part of the former and the western part of the latter are in the lake region.

Although a few feeble attempts have been made to explain the characteristic topography of the Florida lake region, its origin is still practically an unsolved problem.[12] Very few physiographers have ever seen this most interesting region, probably because most of those in this country teach in northern colleges and are free only in summer, which is the rainy season in Florida. It is a remarkable fact that the northern end of the lake region merges into the southern end of Trail Ridge (in the unmapped strip seventeen miles wide, unfortunately), so that when one of these topographic features is explained it ought to give an important clue to the other.

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[10] See G. C. Matson and F. G. Clapp: A Preliminary Report on the Geology of Florida with Special Reference to the Stratigraphy, *Second Ann. Rept. Florida Geol. Survey,* Tallahassee, 1909, pp. 21–173; reference on pp. 32–33.

G. C. Matson and Samuel Sanford: Geology and Ground Waters of Florida, *U. S. Geol. Survey Water-Supply Paper 319,* Washington, D. C., 1913, pp. 25–26 (reviewed in *Geogr. Rev.,* Vol. 4, 1917, pp. 224–226).

[11] For a discussion of other differences see R. M. Harper: Geography of Central Florida, *Thirteenth Ann. Rept. Florida Geol. Survey,* Tallahassee, 1921, pp. 71–307; references on pp. 95–103 and 119–129.

[12] Some of the literature on the subject is referred to on pages 161–162 of the report cited in footnote 11.

AMERICAN GEOGRAPHICAL SOCIETY

Meetings of March and April and Elections to Fellowship. Meetings of the American Geographical Society were held March 20, April 10, and April 24 at the Engineering Societies' Building, 29 West Thirty-ninth Street, the speakers at the respective meetings being Mr. T. Alexander Barnes, Mr. Carveth Wells, and Lieutenant-Colonel William Warfield. Mr. Barnes, author of "The Wonderland of the Eastern Congo" (1922), spoke on "The Eastern Congo and the Land of the Giant Craters." Mr. Wells gave experiences from his commission under the British Government in Malaya in "My Six Years in the Jungle of Malay." The address of Colonel Warfield, formerly of the U. S. Diplomatic Service and the American Red Cross, who has lived and traveled in all the countries of the Balkan Peninsula, was "An Intimate View of the Balkans."

At the meetings of March and April, President Greenough presiding, there were presented with the approval of the Council the names of 68 candidates, who were duly elected as Fellows of the Society.

A Change in the By-Laws of the Society. At the regular meeting of the Society on March 20, at the Engineering Societies Building, 29 West Thirty-ninth Street, there was presented in writing and approved a proposal to make a single change in the By-laws.

"Resolved that an amendment to the By-laws, having been proposed at the regular meeting of the Society on February 20 and approved by the Council on March 15, is hereby adopted as follows:

"That By-law Chapter 3, Section 3, be changed by striking out the words 'nine Fellows of the Society' and substituting therefor 'seven members of the Council'."

Election of Dr. E. Deville to Corresponding Membership. At the meeting of the Society held on April 24 Dr. E. Deville was elected a Corresponding Member. Dr. Deville is a native of France. For several years he served in the French Navy and had charge of extensive hydrographic surveys in the Pacific. He went to Canada in 1874 and entered the service of the Canadian government, rising to the position of Surveyor General of Canada. Recently he has been placed in charge of the Board of Topographical Surveys and Maps, with the title of Director General of Surveys. He is also President of the National Research Committee of Canada and was a delegate from Canada to the conference of the International Geodetic and Geophysical Union in Rome, last May. He is the author of several publications on astronomical and surveying subjects.

Presentation of the Charles P. Daly Medal to Ernest de K. Leffingwell. On March 21, 1923, Mr. Ernest de K. Leffingwell was presented with the Charles P. Daly Medal of the American Geographical Society, the award of which was announced in the April number of the *Geographical Review* (p. 295). The ceremony took place at an Assembly of the University of California, Southern Branch, Los Angeles. Dr. Ernest C. Moore, President of the University, presented the medal and spoke as follows:

"I am commissioned by the American Geographical Society, in its name and on its behalf, to perform a most agreeable agency, that of presenting to you, sir, the Charles P. Daly Gold Medal of that Society for the year 1922.

"Eight years, from 1906 to 1914, you spent in the arctic North upon your self-imposed task—carried on, much of it, without any companion, without technical assistance, and at your own expense—of studying intensively, surveying, and mapping the hitherto almost unknown and altogether unmapped coast of northern Alaska between the Colville River and the International Boundary. Fortitude and a relentless struggle with almost insuperable hardships characterized your undertaking, and, in spite of enormous handicaps, the contribution to geological and geographical knowledge which you were able to make is of great importance. The results of your surveys and observations, published by the Geological Survey as *Professional Paper 109*, 'The Canning River Region of Northern Alaska,' is distinctively your own contribution to science, and through it you have transformed one more region of the earth from an unknown land to a country whose shore line is accurately measured and determined, whose terrain is sketched, and whose fauna and flora are described. Of particular interest to your colleagues and of special value to science is your Theory of the Formation of Ground Ice, which the experiences of nine summers spent upon the north shore of Alaska have enabled you to put forward.

"Your self-denying and arduous labors have already earned for you the Patron's Medal of the Royal Geographical Society of Great Britain (1922). It is now my privilege, on behalf of your own countrymen, your fellow American scientists of the American Geographical Society, to ask your acceptance of this token of its appreciation, of its desire to add your name to the distinguished company of those who have been awarded the Charles P. Daly Medal."

Award of the David Livingstone Centenary Medal to Griffith Taylor. Announcement is made of the award of the David Livingstone Centenary Medal for 1923 to Griffith Taylor, Associate Professor of Geography in the University of Sydney, Australia. This medal, founded by the Hispanic Society of America and awarded by the American Geographical Society, is given "for scientific achievement in the field of geography of the southern hemisphere."

The contributions which Dr. Taylor has made to Australian geography are distinguished by breadth of scope and originality of thought. In brilliant and versatile fashion he has applied the results of his physiographic and climatic studies to problems of settlement and human adaptation. The Australian continent offers a specially favorable field for such studies, many of which have an immediate practical bearing. Such, for instance, is the case with Dr. Taylor's survey of the territory set apart for the Federal District of the Australian Commonwealth (Canberra). The more important of Dr. Taylor's writings on Australian geography include: Australia and Its Physiographic and Economic Aspects (1911; third revised edition, 1921); A Geography of Australasia (1914); The Physiography of the Proposed Federal Territory of Canberra, *Commonwealth Bur. of Meteorol. Bull. No. 6*, 1910; A Physiographic Study of the Foundation of Canberra, Australia, *Geogr. Journ.*, Vol. 43, 1914; Initial Investigations in the Upper Air of Australia, *Commonwealth Bur. of Meteorol. Bull. No. 13*, 1916; The Control of Settlement by Humidity and Temperature, *Commonwealth Bur. of Meteorol. Bull. No. 14*, 1916; Geographical Factors Controlling the Settlement of Tropical Australia, *Queensland Geogr. Journ.*, No. 18–19, 1918, reprinted in abridged and revised form in the *Geogr. Rev.*, Vol. 8, 1919; The Australian Environment, Especially as Controlled by Rainfall, *Commonwealth of Australia Advisory Council of Science and Industry Memoir 1*, 1918; The Physiographic Control of Australian Exploration, *Geogr. Journ.*, Vol. 53, 1919; Air Routes to Australia, *Geogr. Rev.*, Vol. 7, 1919; Economics of Australia, 1920; Australian Meteorology, 1920; Agricultural Meteorology of Australia, *Quart. Journ. Royal Meteorol. Soc.*, London, Vol. 46, 1920.

Dr. Taylor has also added polar exploration to his other activities. He was senior geologist and leader of the western parties on the British Antarctic Expedition of 1910–1913 (Scott's last expedition), on which expedition he has written "With Scott: The Silver Lining" (1915).

The occasion of this award of the David Livingstone Centenary Medal is particularly felicitous. The Second Pan-Pacific Science Congress will meet in August and September of this year in Australia, at which time presentation of the medal to Dr. Taylor will be made by the American Geographical Society's representative.

Publication of "The Vegetation and Soils of Africa." "The Vegetation and Soils of Africa," by H. L. Shantz and C. F. Marbut, *American Geographical Society Research Series No. 13*, published jointly with the National Research Council, is now ready for distribution (for prices and bibliographical details see the list of the Society's Publications).

The work comprises a volume of text and a case of separate maps in color. Treatment throughout has had a practical objective in view—the rational utilization of Africa's resources. The classification of vegetation is based on vegetational formations. This division, employing natural units of ecological significance, readily forms the basis for a division of the country into natural regions of plant growth, of use in the development of agriculture and forestry. Twenty-one formations are distinguished as follows: Mangrove forest, tropical rain forest, temperate rain forest, oak-conifer forest, dry forest, thorn forest, temperate brush, oases, high grass-low tree savana, acacia-tall grass savana, tall grass, acacia-desert grass savana, desert grass, mountain grass, alpine meadow, dwarf palm-temperate grass, marsh grass, desert shrub-desert grass, desert shrub, salt desert shrub, desert. All are distinguished on the map except "desert grass" which is difficult to differentiate on account of lack of data. The scale of the vegetation map is 1:10,000,000. Each formation is discussed in the text as regards botanical description, distribution, climatic conditions, soil conditions, natural production, agriculture, crop potentialities.

Inset in the vegetation map is a soils map on the scale of 1:25,000,000. Sixteen soil types are distinguished. This differentiation is based upon samples collected by Dr. Shantz on his trip from the Cape to Cairo in 1919–1920 and on more or less definite information in the literature of some regions and elsewhere by deduction and comparison. Chapters in the text deal respectively with the soils of temperate and subtropical Africa, arid Africa, tropical Africa.

The land classification map on a scale of 1:10,000,000 is based on the vegetation and soils maps. It shows agricultural potentiality and for what types of utilization each area is suited and the degree of potential productivity within each type. A full explanation of the 23 graded types thus arrived at is given in the text.

The rainfall map on the scale 1:25,000,000 is compiled by J. B. Kincer, of the United States Weather Bureau. It is based on records of 757 stations, and, while similar in its broad features, it presents a more advanced picture than its predecessors.

Mr. Ogilvie's Appointment to the Chair of Geography at Edinburgh. Mr. Alan G. Ogilvie has been appointed Lecturer in Geography at the University of Edinburgh and will take charge of the Department of Geography there on October 1. He will leave the staff of the Society on July 14 after having served nearly three years as Chief of the Hispanic-American Division which was organized in 1920 to initiate certain research work particularly on the Millionth Map of Hispanic America. During the period of his service Mr. Ogilvie has advanced a number of enterprises which the Society has in hand, and as evidence there has already appeared the La Paz sheet of the Millionth Map, in addition to the completion of four sheets and the partial compilation of a score of others. The three-sheet base map of Hispanic America on the scale of 1:6,000,000 has also been produced, and a book by Mr. Ogilvie entitled "Geography of the Central Andes" which was awarded the Milne-Edwards Silver Medal of the Geographical Society of Paris. Material progress has been made on other aspects of the program which will be announced at a later time.

When the Society invited Mr. Ogilvie to come to the United States it was understood that he would wish to return eventually if a favorable opportunity were presented for him to participate in the upbuilding of the institutions of his own country. The Society is fortunate in having persuaded him to extend his stay for a year longer than was first contemplated. It cannot better praise his work than to point directly to the work itself, which is of the highest grade of scholarship. In addition, we have found Mr. Ogilvie a friendly and loyal comrade in the general work of the Society. He has lectured before the Council and Fellows of the Society on his work in Macedonia, collaborated in the preparation of notes and articles for the *Geographical Review*, and, outside the Hispanic-American program, has supervised the preparation of a new map of Alaska on the scale of 1:1,250,000, which the Society prepared for the Alaska Road Commission. More than that, he has entered heartily into the spirit of the whole work of the institution at all times. His advice and counsel have been invaluable on many occasions.

It is one of the aims of the Society to maintain the most cordial relations with all other geographical societies, institutions of research in allied fields, departments of geography, and the like. It is therefore a pleasure to think that through Mr. Ogilvie there will be a continuing bond between the Society and the Department of Geography at the University of Edinburgh in the advancement of geographical science.

The Society has appointed Mr. Ogilvie a Research Associate and will continue to have the benefit of his counsel in carrying forward its program of research in the Hispanic-American field.

GEOGRAPHICAL RECORD

NORTH AMERICA

Remarking of the Initial Point for Surveys and Maps in North America. The recent remarking of the Meades Ranch Station calls attention to the unique importance of this triangulation point. It was in 1901 that Meades Ranch in Kansas was selected as the initial or standard point for all triangulation computation in the United States. The station is one of those forming the transcontinental arc of triangulation and the triangulation along the 98th meridian and therefore is near the center of the area of this country. The geographical position is latitude 39° 13′ 26.686″ N. and longitude 98° 32′ 30.506″ W. These data, together with the azimuth of the line from station Meades Ranch to station Waldo, and also the dimensions of the earth as derived from the Clarke spheroid constitute what was first designated as the United States Standard Datum but later, when adopted also by Canada and Mexico, as the North American Datum.

The original marking of the station Meades Ranch in 1891 consisted of an underground mark, which was a bottle filled with ashes and buried about three feet deep, and a surface mark in the form of a marble post six inches square and two or three feet long placed with the top flush with the ground. On the top were cut the letters U. S. C. S. and two grooves at right angles. The intersection of the grooves indicated the center of the station. In 1922 J. S. Bilby, an engineer of the United States Coast and Geodetic Survey, replaced the old marking by one that was more substantial. The description of the present marking is as follows: "The underground mark is an inscribed metal tablet 34 inches below the surface set in a block of concrete 18 inches square by 4 inches in vertical thickness. The surface mark is a similar tablet set in the top of the center of a block of concrete 36 inches square at the base, 24 inches square on top, and 3 feet in vertical height. It projects 6 inches above the surface of the ground. Two inches of sand separate the two blocks of concrete. The name of the station and the date of establishment are stamped on the tablet. The station Meades Ranch is 12 miles north of the town of Lucas, Kansas."

It was due to the efforts and vision of the former head of the United States Coast and Geodetic Survey, Dr. O. H. Tittmann, and the former Chief of the Division of Geodesy of that Survey, Professor John F. Hayford, that an initial station was adopted for the whole of the United States. Through the influence of the late Dr. W. F. King, Director of the Dominion Astronomical Observatory, Canada adopted the same datum as that used by the United States; and in Mexico similar action was taken through the efforts of Dr. Pedro C. Sanchez, Director of the Mexican Geodetic Commission, and his associate, Professor Aurelio Leyva.

North America is the only continent that has a single initial point for its triangulation and mapping system. This is an ideal which geographers and other scientists of the world wish to see established in each of the continents. It is probable that within the coming generation this ideal will be accomplished through the efforts of the Section of Geodesy of the International Geodetic and Geophysical Union, which has representatives from many nations.

W. Bowie

SOUTH AMERICA

A New Map of Brazil on the Millionth Scale. The Club de Engenharia of Rio de Janeiro has signalized the centenary of Brazilian Independence by a notable advancement of the International Map of the World. The plan of the Club, which was announced in 1916 and undertaken in commemoration of the anniversary with the co-operation of the Federal and State Governments, comprises nothing less than the publication of the fifty-two sheets, in whole or part Brazilian, of the Carte International du Monde or International Map of the World on the scale 1:1,000,000. Thirty-one of the sheets have now been published simultaneously and have been received by the Society through the courtesy of Dr. Francisco Bhering, who is responsible for the production of the map. They cover the Amazon River and all Brazilian territory north of it, as well as all the coastal zone, save that the Rio de Janeiro sheet is still unpublished, while the latter sheet forms the most important gap in a group of ten sheets south of 16° S. now issued. There are also three sheets to include the oceanic islands. Thus we have for the first time a map of about half of Brazil on a reasonably large scale and showing physical as well as cultural features.

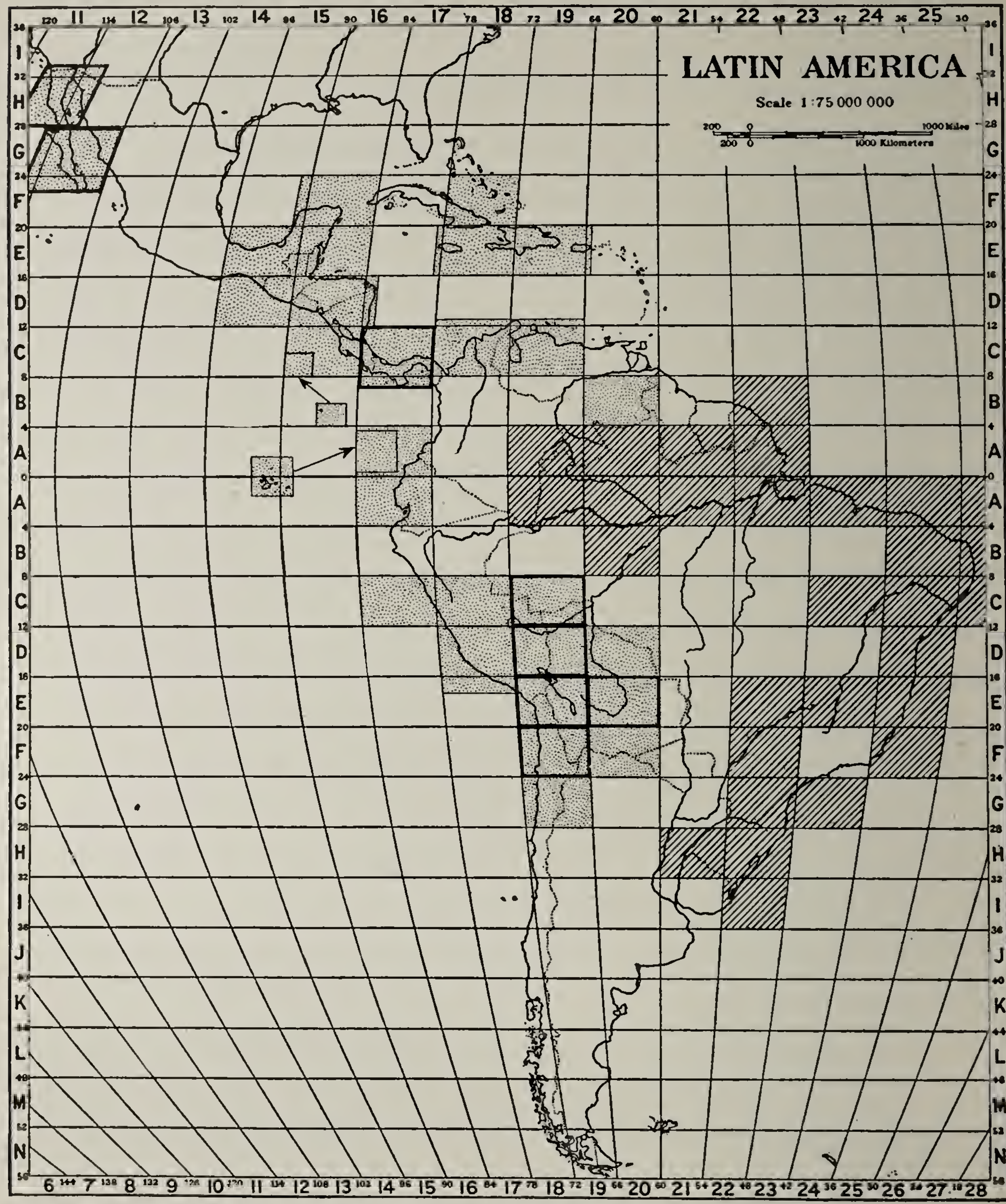

FIG. 1—Index to the sheets of the Millionth Map in Hispanic America and Brazil, indicating by a ruling the sheets (pertaining to the International Map) published by the Club de Engenharia do Rio de Janeiro, with the exception of three island sheets (N.A.–25, S.A.–25, S.F.–26). The stipple indicates sheets of the American Geographical Society's series now in hand. The sheets of this series which are in process of fair drawing or already printed are enclosed by thick lines.

This is not the place in which to discuss the cartography in detail. It will be sufficient to state that all of the new sheets are termed "Provisional Editions." They are attractive, well drawn, and well printed. They conform in extent, in general appearance, and in many details to the recommendations of the International Map Conference, although there are important departures which will doubtless disappear when the regular edition is published. The American Geographical Society is interested in promoting, through the various governments concerned and through its own work, the early completion of the Millionth Map of Hispanic America and Brazil and therefore looks forward with keen expectation to the publication in full of this provisional series. To have produced thirty-one sheets in so short a space is a great achievement, which brings credit to Dr. Bhering and all concerned. It would be an event of the first importance to Hispanic-American geography if similar results could be brought about in other countries, especially Mexico, Chile, and Argentina.

EUROPE

Physical Obstacles to the Development of the Danube as a Waterway. For 400 years during Roman rule the Danube was an important artery of commerce. Many vestiges along the banks bear witness to this ancient utilization of the river—traces of a channel excavated in the reef of the Iron Gate and other devices to help the navigator in that difficult section; the remains of the bridge at Turnu Severin and the admirable road of Trajan; remains of commercial stations in the present Rumanian reaches. Traffic on the river again flourished exceedingly during the preëminence of Genoa and Venice. Compared with classical and medieval times the relative position of the Danube today is greatly inferior and far below what might be expected in view of its length and volume, its latitudinal course through the great mountain barriers of Europe, and the populous character of the bordering states. It is difficult to secure figures for comparison, for along the Danube there is no consistent method of keeping records. According to figures published by the Danube Conference at Budapest in 1921 the traffic for 1912 amounted to under 14,000,000 metric tons. (It was distributed between the several reaches thus: Bavarian, 433,636; Austrian, 2,590,000; Hungarian, 5,093,000; Rumanian, 5,183,668; Bulgarian, 612,000.) Probably these figures represent a considerable amount of overlapping. On the Berlin canal system in the same year traffic amounted to 18,500,000 tons; on the Elbe system, 25,700,000 tons; on the Rhine system, 75,000,000.

Many causes have contributed to the retarded development of the Danube, political and economic as well as geographical. It is particularly the last that are considered by Hilda Ormsby in a paper read at the 1922 meeting of the British Association and published in the April number of the *Scottish Geographical Magazine.* In its upper course as far as Ulm, usually considered the head of navigation, the Danube flows through a deeply entrenched valley too big for the stream. During late summer, autumn, and winter navigation is impeded by low water. Ice is another obstacle, the more obnoxious because it often begins when grain trade is at its height in November. At least half the traffic goes off the river during winter.

Swiftness of the current also presents a difficulty, as, for instance, where the river flows along the edge of the Bohemian massif. More important is the obstacle of the Carpathians where the river flows through a defile about 140 kilometers long. This stretch, usually known as the "Iron Gates," includes the cataract sections of the gorges of Klissura and the Iron Gate proper. The Iron Gate proper is the great reef of rock that formerly stretched almost across the valley just below Orshova and through which a channel was blasted in 1896. In addition to swiftness of current, average depth in the low-water season is so low as to be critical. In the autumn of 1920 all navigation here was suspended. When the wind "Kosova" blows up the defile, the water in the cataracts may be lowered 30 centimeters.

Except for the Carpathian section there would probably be no difficulty in maintaining a 3-meter channel in the Danube from the mouth at Sulina upstream to Vienna or certainly to Bratislava. Many projects have been and are under consideration to overcome the obstacle by canalization or by deepening of the present channel, but it presents a formidable task (see for instance Antonin Smrček: Les cataractes du Danube et la navigation, *Le Danube International,* Vol. 2, 1921, No. 4, pp. 12–14; No. 5, pp. 10–15; No. 6, pp. 12–16). As it is it takes on an average three times as long to come upstream as it does to go down.

There remains another geographical factor less susceptible of transformation. The Danube flows eastward from industrial regions to regions still almost entirely agricultural. Manufactured goods of small bulk have the advantage of the downstream direction; heavy bulk goods have to move up against the current, and the cost is great in fuel as well as time.

Nor will this be altered by the opening of the projected Rhine-Main-Danube canal. In the article on Rumania elsewhere in this number of the *Review*, comment has been made on the surprising amount of trade between Rumania and other Danubian countries carried on the rail. All the Danubian ports have important rail connections and are rail distributing centers. Furthermore, there is the competition of the sea route. Before the war it was cheaper to send Rumanian wheat to Bavaria via Hamburg, for the British carriers brought with them bulk cargoes of British coal as well as manufactured goods to exchange against the grain.

In connection with this comment on the Danube as a waterway, reference may be made to the helpful large scale map (1:125,000) of the river, "Karte der Donau von Ulm bis zur Mündung," published by the Erste Donau-Dampschiffahrts-Gesellschaft, Vienna. It gives profiles of the river and among other features shows railroad connections, bridges, steamship stations, winter harbors.

The "Warm Island" of Upper Alsace. Weather records, flora, and fauna indicate the existence of a "warm island" in Upper Alsace centered around Colmar (Albert Knörzer: Die Wärmeinsel am Ostfusse der Vogesen, *Forsch. zur Deutsch. Landes- und Volkskunde.* Vol. 22, 1922, Stuttgart, pp. 249–277). A comparison of the monthly and yearly mean temperatures of Colmar with those of Strasbourg to the north and Mulhouse to the south, at either end of the Rhine garben, shows that Colmar is distinctly warmer than either. The same difference appears especially between Colmar and Strasbourg when the values are reduced to sea level. The cause of this excess appears to be the Vosges föhn, a west or southwest wind, dynamically warmed and dried by passing over the mountains and particularly pronounced at Colmar on account of the local topography. Colmar is the warmest meteorological station north of the Alps. To reach spring and summer means similar to those of Colmar, one must go south as far as Lyons or cross the Alps to Lugano.

From more southerly places Colmar is, however, distinguished by the occurrence during the winter of sudden cold snaps of brief duration. The surrounding mountains are comparatively high, and the valley is narrow, so that Colmar lies as within a big kettle. Under certain conditions this circumstance which favors the high summer temperatures causes the accumulation of a sea of cold air. Apart from these cold snaps the winters are mild. The average number of "winter (ice) days" (maximum not above 0° C.) is 16, of "summer (hot) days" (maximum above 25° C.) is 49. It may be noted that the warm island is also a dry island. It has the least cloudiness in Alsace-Lorraine.

In the warm island grape vines grow luxuriantly, and peaches, prunes, plums, almonds, and apricots abound. Such a southern tree as the cypress will grow in protected spots. Southern species do best on the hills slightly above Colmar where they are safe from the sharp temperature inversions of the valley floor. So destructive are these untimely spring frosts that bugle signals at night are employed to warn the town that frost is imminent and that smudge fires should be started. The wild plants, as well as those in cultivation, lend a southern aspect to the vegetation; many insect species here reach their northern limits, beautiful southern butterflies and beetles suggest the Mediterranean. Most of the donkeys of Alsace-Lorraine are concentrated here, so that even the beast of burden is typical of the south. The warm island, indeed, presents a charming miniature of a southern land transplanted into more northern surroundings.

ELEANOR S. BROOKS

The Morphological Regions of Bohemia and the Site of Prague. Dr. Julie Moscheles, of the German University in Prague, has prepared an excellent article on the morphological regions of the Bohemian upland (Les régions morphologiques du massif bohémien, *Ann. de Géogr.*, Vol. 32, 1923, pp. 41–57), in which a broad knowledge of her country is shown by the clearness given to the explanatory physiographic descriptions of its different subdivisions. The leading feature of the greater part of the country is a peneplain, worn down on crystalline and deformed stratified rocks and now variously warped, uplifted, and broken, so that it has at present unlike aspects and exhibits divers stages of dissection in different areas. One of the most significant items about the peneplain is that its southeastern part still possesses an even surface, smoothed down to a marine platform by the waves of an epicontinental sea before regional uplift took place; and the division between the smoothly abraded platform and the non-abraded, rolling peneplain is still marked by a line of weathered cliffs. The southern border of the platform is defined by a flexure, where it pitches down to lower ground toward the Danube. Among the occasional accounts of ontographic features the site of Prague may be mentioned: To the south several converging branches of a main, north-flowing river, the Moldau, which in their headwaters still flow in the broadly open and shallow valleys of the uplifted peneplain, are sunk in narrow young valleys below the upland surface farther down stream and thus divide it into contiguous areas that converge in their pointed northern ends toward the district where the river branches makes their junction. The narrow valleys being inconvenient for road location, the long established highways are laid on the undulating upland, and therefore they also, like the rivers, converge northward toward the upland points. In that district a belt of relatively weak strata, infolded into the crystalline mass with northeast-southwest trends, is now broadly excavated in a new lowland below the upland peneplain; and in crossing this lowland the Moldau divides into several arms, where fording is practicable. There Prague was naturally established, as if at the apex of a fan of roads running together from all southern Bohemia.

W. M. Davis

The Site of Toledo, Spain. Juan Carandell's "Topografía comparada de cuatro locali dades ribereñas españolas: Toledo, Montoro (Córdoba), Arcos de la Frontera (Cádiz), y Castro del Río (Córdoba)" (*Bol. Real Soc. Española de Hist. Nat.*, Vol. 22, Madrid, 1923, pp. 440–452) illustrates superposition of streams on buried landscapes with four admirable Spanish examples which American readers will find new and interesting.

Carandell makes his examples lead up to Toledo, as is natural in Spain where "every schoolboy" knows the external facts of that city's romantic site. A few words on those facts may be in place. East and west of Toledo the Tagus winds its lovely *vega* of richly cultivated alluvium through the open Tertiary plain of New Castile. At this one point the river takes a sudden half turn southward into the hills that border the plain and quickly back again, enclosing within its rather open meander ground enough for the fortress city of the Visigoths. The result is a spectacular city site. Toledo "stands majestic on its hills, with its long lines of palaces and convents terraced around the rocky slope, and on the height the soaring steeples of a swarm of churches piercing the blue, and the huge cube of the Alcázar crowning the topmost crest and dominating the scene. The magnificent zigzag road which leads up the steep hillside from the bridge of Alcántara gives an indefinable impression, as of the lordly ramp of some fortress of impossible extent" (John Hay: Castilian Days, Boston, 1880, p. 184).

The horseshoe of the river into the mountains is in a gorge in granite. The mystery of Toledo that Carandell sets himself to solve is why the Tagus left its open plain of easily eroded Tertiary rocks to plunge into the granites and carve this gorge. The answer in the Davidian explanatory style is that the river here has an incised course superimposed on the resistant granites from Tertiary beds that once overlay but have here disappeared in the mature dissection of the plain as a consequence of uplift. Three explanations cited refer to an "old channel" which the river has reoccupied, but which is left unexplained. These Carandell criticizes acutely and supports his own explanation with excellent block diagrams. Corroboration of the explanation is found in the behavior of the Guadalquivir as it flows westward along the foot of the great fault separating the Sierra Morena on the south from the *campiñas* of Córdoba and Jaen, ever and again swinging against the old rocks and incising its channel partly or wholly into them. So also at Arcos de la Frontera on the Guadalete, not far from Cadiz. In this case the river has not cut through the Tertiaries to the hard rocks lying unconformably below. All of these are craggy city sites within meanders of streams which have abandoned open plains to make brief excursions into hills.

It is gratifying to see the increasing attention given in Spain to modern aspects of geography. It is interesting to meet peneplain under the form *penillanura*. It is a great satisfaction to have the romantic city of Visigoths, Moors, and Spaniards set on a solid physiographic foundation.

Mark Jefferson

Influence of Geographical Factors on English Agriculture. In his presidential address to the Geographical Association of Great Britain, printed in the Spring number of the *Geographical Teacher*, Sir John Russell gave an interesting résumé of the ancient and modern agricultural systems of England in relation to geographical factors.

Under the old system, which may be said to have obtained until the end of the eighteenth century, i.e. until the beginning of improved transportation, a simple uniform scheme of food production prevailed throughout the country. Each region had to produce bread, beer, and meat sufficient for its own consumption. Mixed farming was the result, the only important exception being the sheep farming which raised wool for export. At the same time differences in rainfall, soil, and temperature caused differences in the crop grown for bread (oats and beans replaced wheat and barley in difficult regions), the animals reared (sheep in regions too poor or dry for cattle), and the general prosperity. On the western hill slopes the risk of failure owing to a wet summer was greater, and crop failure in early days meant famine. The yield was greater and the risk less in the east where prosperity meant leisure and advance in culture. "In many parts of the country the rainfall map gives the key to the distribution of monasteries, abbeys, and wonderful churches—the signs of wealth (mainly agricultural) in medieval times—and to the magnificent Jacobean and Georgian residences which indicate the agricultural wealth of later days." The effect of soil differences in conjunction with rainfall is also marked. The heavy intractable clay soils of the Weald were betrayed in the general poverty of the region—parishes were large, roads notoriously bad, the inhabitants backward.

Little of the ancient system of agricultural uniformity survives today. Money crops are grown where possible, and everywhere specialization is increasing. Speaking generally, rainfall is the determining factor in the general distribution of specialization. A north-south line running through Durham to Southampton divides the west, which has a rainfall of over 30 inches a year, from the drier east. As a general rule the east is the crop-growing area, the center combines crop growing with dairy farming, while the wetter hilly west is given over to stock raising, pasturing, and fruit growing. Temperature is the chief control over the important specializations in early produce—vegetables, fruit, and flowers. Local conditions of relief and soil further influence the nature of the specialization. Proximity of large urban centers is a great stimulus to such development. Even in early days the presence of centers of civilization must have encouraged a certain degree of specialization. "Kent, always the highroad of continental culture, has grown fruit from very early days."

Seasonal specializations have arisen in the animal industries. Bullocks are reared in the hills of the west or north, sent to the Midlands or good grasslands of the west to be fattened for autumn killing, or, if not ready then, sent farther east to be fodder-fed for winter killing. The sheep industry has also been revolutionized, in the South Downs for instance, where by winter feeding on neighboring farms the number of sheep per thousand acres that can be produced from the chalk hills is increased three-fold.

E. M. Sanders

AFRICA

House Types in the Cameroons. A contribution towards the literature of the house type as a geographical fact is made by Mr. L. W. G. Malcolm in his article "Huts and Villages in the Cameroon, West Africa" appearing in the January number of the *Scottish Geographical Magazine.* The West African countries afford good ground for such a study. The well-defined vegetational zones offer, in north-to-south cross section, environments ranging from heavy tropical forest to desert or semidesert, and there is a corresponding range of civilizations. In each the hut type is characteristic.

The tribes of the forest area, mainly of Bantu origin, build a long, low, right-angled hut with a gable roof. The frame is of timber or strips of raffia palm, the walls are of woven mats, strips of bark, or mudded; the roof is thatched with palm leaves or bark. The huts are joined end-on to form the village unit with the road running between two facing rows. "In some of the villages in the Cameroon the double line of huts, with the road running between, extends well over a mile in length."

The boundary between forest and grassland is sharply defined in the Cameroons; hut types, however, exhibit some transitional forms from the forest type to the characteristic grassland hut of the Sudan negro. This latter is round in plan and has a conical roof. The walls are of matting, woven strips of raffia palm, or mudded; the roof is generally thatched with grass. Separate huts form a number of dissociated compounds which radiate in all directions from the chief's compound.

Certain tribes of the Logone River, in the Lake Chad drainage basin, build conical huts of mud thirty feet high. As one approaches the arid zone on the borders of which lies Lake Chad the use of mud as a building material becomes more prevalent. As Vidal de la Blache has remarked, "C'est en Afrique qu'on peut le mieux suivre, avec l'appauvrissement graduel de la végétation l'emploi de plus en plus exclusif de la terre pour les constructions." About Lake Chad the principal dwelling is of mud, right-angled and with a flat roof, a Saharan type.

Avifaunal Regions of Africa in Relation to Vegetation. The present-day distribution of bird life in Africa may be interpreted largely on the basis of the vegetation. The most important control over the vegetation of the continent is rainfall; hence there are close resemblances between the avifaunal and rainfall maps. A map of the avifaunal regions prepared by James P. Chapin, of the American Museum of Natural History, is discussed by him in the paper "Ecological Aspects of Bird Distribution in Tropical Africa" (*The American Naturalist*, Vol. 57, 1923, pp. 106–125). For the rainfall map reference should be made to that accompanying Shantz and Marbut's "The Vegetation and Soils of Africa" (*Amer. Geogr. Soc. Research Ser. No. 13*, 1923). Excluding Africa north of the Sahara, which belongs to the Palearctic Region, the following major subdivisions are recognized for the remainder of the continent (Ethiopian Region). I, West African Subregion: A, Guinean Forest Province; B, Guinean Savana Province. II, East and South African Subregion: C, Humid Montane Province; D, Sudanese Province; E, Northeast African Province; F, Eastern and Southern Province. (Mr. Chapin carries his division to 17 minor districts. Compare the note "The Faunal Regions of Africa, Based on the Distribution of Fishes," *Geogr. Rev.*, Vol. 6, 1918, pp. 371–372.)

Nearly the whole of Africa lies between the annual isotherms of 20° C., often taken as the limits of the tropical zone. Within this the effects of temperature alone are important only at altitudes exceeding 5000 feet, where the subtropical zone begins. The altitudinal temperate zone, beginning at 10,000 feet on the equatorial peaks, is very limited in area and plays an insignificant part in African bird distribution in contrast with the rôle of this zone in tropical South America. Similarly, as one proceeds north and south of the equator, the latitudinal factor has weight as it affects precipitation rather than temperature.

Rainfall is the basis of the prime subdivision. The West African subregion is the principal area, with a rainfall of over 60 inches. Within this division seasonal distribution of the rains is important. Thus a rainfall of 150 inches in Sierra Leone is insufficient for a continuous forest cover because of the four-months' dry season; on the other hand in the Upper Congo places with scarcely 65 inches of rain are clothed with superb unbroken forest. The equatorial forest belt is characterized by extreme scarcity of grasses, and its borders constitute a sharp line of faunal demarcation. It forms the southern limit of many species. In the east, where the forest barrier breaks down, species find their way far south. Some migrants, however, boldly cross the forest where they may be seen regularly in the clearings. Migrations of African birds also show the influence of rainfall. Migrations are not, of course, on the scale of those of the cooler zones, and the small birds of the equatorial regions are very sedentary; but north and south of the equatorial belt, where the effects of an annual dry season are felt, seasonal movement takes place. Many birds move from the drier Sudan, for instance, southwards to the savanas on the edge of the Congo forest, a journey of some few hundred miles. Some cross the equatorial belt, as we have said, or go round it, to take advantage of reversed seasons on the opposite side of the line.

In South Africa the boundary between the avifaunal districts (Southeastern Veld and Southwestern Arid District) runs north and south in sympathy with the rainfall. For similar reasons north of the equatorial belt the divisions run east and west. Even in East Africa, where the effects of topography are most marked, it is largely the way in which rainfall is involved that matters.

The Climate of Southwest Africa. The cold Benguella Current brings to the coast and interior of Southwest Africa climatic anomalies which are analogous to those which the Humboldt current brings to corresponding latitudes of the western coast of South America (compare R. C. Murphy's paper on the oceanography of the Peruvian littoral in the January number of the *Review*). Most interesting and important of these are the winter rains of the interior which Dr. Leo Waibel discusses in "Winterregen in Deutsch-Südwest Afrika" (Abhandl. aus dem Gebiet der Auslandskunde, Vol. 9 (Section C, Naturwissenschaften, Vol. 4) University of Hamburg, 1922)—a study of the influence of the Benguella Current on the climate and vegetation of that part of the former German possessions located between latitude 24° and 28° S. and longitude 14° and 20° E. The discussion is based on reports from government stations and volunteer observers particularly for the year 1913–1914 but, in many cases, for much longer periods.

The northerly, offshore bearing of the current produces between current and coast a strip of ocean in which upwelling lowers the surface temperature even below that of the surface of the current itself and an average of 8° C. colder than would be expected in this latitude, while the average temperature of the coast is 5° to 6° C. colder than its latitude would indicate. Isotherms drawn here run parallel to the coast. Of two stations, Swakopmund and Lüderitzbucht, the more northerly, Swakopmund, has the lower temperatures, owing to the fact that the prevailing south to southwest winds are really the southeast trades bent landward as they pass from land to sea so that the wind at the more southerly station arrives by a shorter curve over the cold ocean than that at the more northerly. Swakopmund had an average of 15.2° C. and Lüderitzbucht 16.3° C. Also the average yearly temperature increases from the coast inland in spite of the fact that the coastal highlands rise to some 2000 meters and border an interior plateau with an average altitude of about 1200 meters. For three stations, Lüderitzbucht, Kuibis, and Keetmanshoop, extending from the coast inland in the order named, the average yearly temperatures were 16.3° C., 25° C., and 25° C., respectively. Both summer and winter the interior is warmer than the coast. The difference between the average summer temperatures of interior and coast was 12.5° C., between winter averages 5° C. Such is the difference between sea and land temperatures that, although coast and interior are blown upon by moisture-laden winds, yet, for 100 and more kilometers inland, the region is practically rainless to the north and only very sparsely watered to the south. The moisture of the landward-borne air quickly condenses over the cold Benguella Current so that fog is there almost a permanent feature. On reaching the warmer land, however, the moisture is dissipated, and the cloud masses drift far inland often rising over the coastal highlands without producing rain. At times, particularly in winter when the difference between the temperatures of coast and interior is least, precipitation occurs in the highlands and on the interior plateau in the south.

Such rains as reach the interior in summer are largely thunderstorms from the northeast. Waibel calls these summer rains even though their occurrence may extend into the winter season. By winter rains he means those rains which come to the interior by south to southwest winds from the Atlantic. Their occurrence is due to the fact that the territory under discussion backs well up against the horse latitudes so that with the northward shifting of the heat equator there comes to the southern part of this area the edge of many of the cyclonic storms by which the temperate zone is characterized.

Three distinct vegetation zones result from the various ways by which moisture reaches this region—the evergreen vegetation of the coast constantly bathed in mist and fog; the summer green vegetation of the north watered by the northeast showers; and the winter green vegetation of the south and south-central. Between these latter two occurs a zone of summer and winter green; that is a zone watered by both summer and winter rains in which the growth of vegetation has two maximums. It must be understood, however, that such expressions as evergreen, summer green and winter green are relative terms only. The region is desertic or semidesertic—at best sparsely watered.

AUSTRALASIA AND OCEANIA

The Evolution of Ocean Island. Among the fundamental problems of physical geography given a regional basis by the Pan-Pacific Scientific Conferences is that concerning the late geological history of the Pacific floor. This comprehensive problem calls for many lines of investigation, and in this connection it is interesting to note the suggestions for research made by Mr. Launcelot Owen as a result of his study of Ocean Island (Notes on the Phosphate Deposit of Ocean Island; With Remarks on the Phosphates of the Equatorial Belt of the Pacific Ocean, *Quart. Journ. Geol. Soc.*, London, Vol. 79, 1923, pp. 1–15).

Many of the Pacific islands within 10 degrees of the equator are known for their phosphate deposits. The low oceanic islands of the east, with smaller and more recently formed deposits (leached guano), were first exploited (see R. A. F. Penrose: Nature and Origin of Deposits of Phosphate of Lime, *U. S. Geol. Survey Bull. 46*, Washington, D. C., 1888), The richer islands lie between longitude 140° E. and 180° E., and those being worked today include Angaur, Makatea (near Tahiti), Nauru (compare the note by T. J. McMahon, "Nauru: A Treasure Island of the Pacific," *Geogr. Rev.*, Vol. 11, 1921, pp. 446–448), and Ocean Island.

Ocean Island lies on the equator in longitude 169° 30′ E. It is practically circular in outline with a circumference of 6 miles and rises to a maximum height in the center of 300 feet above sea level. Vertical and much-eroded cliffs reaching as great a height as 30 feet, line the island; and it is bordered by a platform of marine erosion 100 yards wide. The base of the island is a typical fossil coral reef much altered by marine and subaerial erosion. It exhibits a series of steps or terraces at least three of which can be traced entirely round the island; they are gently tilted towards the south-southeast. Overlying this base is the phosphate deposit, averaging somewhat less than 50 feet in thickness. It consists of a completely leached guano with detrital limestone, and the underlying rock has also been changed into a phosphatic rock. The original guano, undoubtedly due primarily to bird droppings, was deposited on the slowly rising reef. There is no sign of submergence since this deposition. A slight movement of elevation seems to be in process at the present time. Geological evidence of the differential movement is confirmed in an interesting way by a study of the variation in composition of the deposit. The percentage of phosphate is found to vary regularly with depth. A series of "isophosphatic" lines can be established which are conveniently referred to a datum line of 80 per cent phosphate (tricalcium phosphate) content. On this basis the quality of the phosphate at any point of the island can be predicted. Direction of the phosphatic planes confirms the evidence of tilting. Similar study of other phosphate islands is much to be desired.

The Use of Remote Islands as Meteorological Stations. The successful functioning of the meteorological station installed on Jan Mayen Island (see the *Geogr. Rev.*, Vol. 12, 1922, p. 653) has drawn attention to this use for remote islands situated in areas critical from the standpoint of weather prediction. From the antipodes come two recent proposals for such utilization.

Captain J. K. Davis, Commonwealth Director of Navigation, spent the hurricane season, November to April, 1921–1922, investigating the possibilities on Willis Island (Willis Island Meteorological Station: Report by Captain John K. Davis, *Parliamentary Paper, No. 36*, Commonwealth of Australia, 1922). Willis Island lies in latitude 16° S., in the Coral Sea between the Queensland Coast and the Louisiades. Many storms originate near latitude 10° S. and, moving southwestward, pass over Willis Island before recurving in their parabolic path. Any extensive disturbance reaching the Queensland coast first travels over the island. (See Plate 33 in "Hurricanes and Tropical Revolving Storms," by E. V. Newnham, reviewed elsewhere in this number of the *Review*.) Willis Island itself is a mass of coral sand 468 by 150 yards in extent, surrounded by a coral beach. The climate is characteristic of tropical islets; the temperature range is very small, the evenness of the night temperatures being especially marked, and the humidity high. Establishment of a permanent station here is strongly recommended.

The case of Sunday Island in the Kermadec group is somewhat different. This island, the largest of the group, lies 600 miles northeast of Auckland, N. Z., halfway to the Tongas. It is a mountainous island of volcanic origin and covers an area of 7260 acres. In the past it was frequented by whalers, and attempts at settlement were made but abandoned largely on account of its isolation. The water supply of the island is rather scant, but the soil is productive and the climate genial. There are, in fact, distinct possibilities for its future as an agricultural settlement as well as a meteorological station (D. C. Bates: Weather Research on the Kermadec Islands, *New Zealand Journ. of Sci. and Technol.*, Vol. 5, 1922, pp. 265–274). In this latter respect the value of the island lies in its position in the path of many tropical storms which affect the weather of North Island, New Zealand, and especially the Hawkes Bay district. Furthermore, it would provide valuable data for the ocean weather forecasts that are sent out by the Meteorological Office of the Dominion from Awanui, at the extreme northern tip of North Island.

Modern Australia and Recent Studies in Australian Discovery and Exploration. To "clear away much ignorance and misunderstanding concerning Australia, the picture of whose conditions has been largely left to the doubtful artistry of traveling politicians" was a task undertaken by several of the leading economists, historians, jurists, sociologists, and educators of the southern continent in a volume published in 1920 and entitled "Australia:

Economic and Political Studies." The editor, Professor Meredith Atkinson, Head of the Department of Sociology of the University of Melbourne, supplies an introductory chapter, "The Australian Outlook," in which he interprets the Australian spirit of independence.

Other chapters deal with political systems and political consciousness, with labor and the judicial regulation of industrial conditions, with education and the women's movement, with land settlement and legislation, with Australia's relation to the Empire and to the other powers controlling the Pacific, with the "White Australia" policy, and with the distribution of private wealth. Professor Griffith Taylor's discussion of the "Physiographic Control of Settlement" is an important essay in human geography.

The writers of the volume, though they give expression to keen and assertive national pride normal in a young nation, nowhere descend to the uncritical and prejudiced utterances of the chauvinist. They are able to discern the flaws as well as the merits in the institutions of their land. If in Australia they are conscious of a greater measure of social justice than is enjoyed elsewhere, a more equitable distribution of wealth, more humane laws governing conditions of work in factory and field, a greater and possibly more salutary degree of political power in the hands of labor, they are not blind to the facts that class consciousness is more bitter; that strikes are more frequent and paralyzing; and that the more the trade unions gain, the more insistent and unreasonable become their demands. These writers feel with an intensity almost akin to crusading ardor that the preservation for the world of all that is best of British tradition and standards depends on the maintenance of a "White Australia," or a barrier against the menacing floods of color. They are not, however, unwilling to concede that Australians themselves have failed to make the most of what their own continent offers and that justification of "White Australia" will come only when the resources of that continent are developed by white hands to their full potentiality of development. Nor are they unwilling to grant that, through official and private inefficiency as well as through a widespread disinclination to shoulder the burden of a hard and lonely life in the "back-blocks" and Northern Territory, these resources are not at present being so developed.

The unity of treatment which "Australia: Economic and Social Studies" misses through diversity of authorship; and the detached point of view which it misses because it is written by dwellers in the country with which it deals, are both to be found in President C. F. Thwing's recent volume on "Human Australasia" (Macmillan, 1923). This study has the advantage which the work of a discriminating foreign traveler occasionally possesses over that of the native authority.

We learn from both of these volumes that the general level of primary and secondary education in Australia is high and that much excellent work is being done in the universities. Australian civilization is, however, peculiarly in the formative stage. The present phase of intellectual initiative is characteristically illustrated by Professor Atkinson, who observes that though "no country in the world has been more forward in social experiment . . ." none "has been more backward in contributing to the world-stream of sociological thought." In the geographical field this same spirit that so lately was engaged in pioneering now turns with especial pleasure to the investigation of those adventurous voyages and explorations, the recent forerunners and determinants of colonization and of settlement. If Australians have not contributed much to the analysis of their institutions, they have, quite characteristically, devoted themselves to the more congenial studies of the discovery of the coasts and exploration of the interior of their vast realm.

Something of the recent progress of these researches was indicated in a note in the July, 1922, number of the *Geographical Review.* Three books, however, not alluded to in that note, deserve particular mention. Two of these are concerned with the exploration of limited portions of the continent and are almost exclusively of local interest. These are Bessie Threadgill's readable monograph on "South Australian Land Exploration, 1856 to 1880" (Historical Compilations Based Upon the Study of Original Documents, No. 3), in 2 parts, text and maps, Adelaide, 1922 (in continuation of Gwenneth Williams' "South Australian Exploration to 1856," Adelaide, 1919) and R. L. Jack's "Northmost Australia: Three Centuries of Exploration, Discovery, and Adventure in and Around the Cape York Peninsula, Queensland, with a Study of the Narratives of All Explorers by Sea and Land in the Light of Modern Charting, Many Original or Hitherto Unpublished Documents, Thirty-Nine Illustrations, and Sixteen Specially Prepared Maps," 2 volumes, London, 1921. The latter, well defined by its title, is a monumental work—evidently very much a labor of love—and one which leaves little or nothing further to be done in its particular field.

The third book is one of far more general importance, a contribution not only to the history of Australian geography but one which supplies an important chapter, long missing in English, of the history of geography as a whole. This is an attractive volume by Professor G. Arnold Wood, entitled "The Discovery of Australia" (Macmillan, 1922). All deference to the arguments of the late Henry Vignaud notwithstanding, the discovery and mapping of the coasts of America should probably be regarded as an incident in the search for a westward route to the Orient. Similarly, the discovery and mapping of the coasts of Australia, until Cook swept "the cobwebs of the South Sea with the dust-broom of victorious common sense" (p. 399) may be regarded as an incident in the search for an immense southern circumpolar continent reaching far north into temperate or even tropic latitudes. In the existence of this "austral continent" many men had believed since the days of the Greeks, and the persistence of their belief, the unceasing influence which it exerted upon the growth of geographical theory, upon cartography, and upon the course of exploration until as late as the mid-eighteenth century was one of the major and most remarkable episodes in geographical history. The fundamental discussion of this subject in any language is Armand Rainaud's "Le continent austral" (Paris, 1893), but Professor Wood's volume, which owes much to Rainaud, is the first adequate treatment of it in English.

It has been well said that Australia turns its back to the rest of the world; the only genuinely hospitable coast, that which faces the immense wastes of the southern Pacific, was the last coast to be explored. Conceivably the entire course of colonial and imperial history might have been very different had the natural resources and temperate climate of southeastern Australia, Tasmania, and New Zealand become known at the time when the northern and western shores were being visited by Portuguese or Dutch. Professor Wood shows us the reasons for this critical fact in the history of the discovery of Australia, why for one hundred and fifty years the course from Samoa slightly south of west "had been deliberately declined by seaman after seaman—by Schouten, Tasman, Roggeveen—as certain to lead to great danger on the unknown coast south of New Guinea," and why the route from the west and northwest into these same waters was as studiously avoided.

Written in a light-hearted vein, full of appealing humor and human touches, "The Discovery of Australia" seems essentially sound in its broader narratives and conclusions. Certain controversial matters are treated with easy-going assurance. Despite the not always unimpeachable authority of John Fiske, we are not at all convinced that Columbus "had read a Latin translation of the book of Marco Polo" nor that "his copy, with marginal notes in his handwriting, still exists" (p. 70). Neither are bibliographical references satisfactory which omit place and date of publication and authors' Christian names and initials. But these are minor blemishes. As a whole, "The Discovery of Australia" not only agreeably tells a fascinating story but contributes materially to our understanding of difficult and obscure, but important, problems in the history of the evolution of geographical knowledge.

POLAR REGIONS

The Mineral Resources of Greenland. As in the case of so many other colonial lands the early exploration of Greenland was fostered by a belief in the existence of metals and precious stones. The earliest rumor of mineral wealth dates back to 1000 A. D. Baffin reported on certain mineral prospects in the seventeenth century. Hans Egede expressed optimistic opinion on the value of Greenland's asbestos in the early eighteenth century, from whence on several serious investigations were undertaken culminating in the series of official geological expeditions in the last fifty years. The results show a wide variety of minerals scattered over the narrow belt of habitable Greenland (43,130 square miles), rarely concentrated into commercially exploitable deposits (S. H. Ball: The Mineral Resources of Greenland, 60 pp., Copenhagen, 1922; separate from Vol. 63 of the *Meddelelser om Grønland*). There is, however, a marked exception in the cryolite of Ivigtut. This deposit has an altogether unique interest. It is one of the most northerly of the world's large mines. It is the only known locality in which the valuable aluminium ore is found in commercial quantities. Through royalties on exploitation it provides the greater part of the revenues of the self-supporting colony.

Ivigtut is in southwestern Greenland, latitude 61° N. The mine is situated in a small basin inset in the sheer walls of the fiord which rise to heights of over 1000 feet from the sea. The ore is mined in a great open cut and sorted by water; hence the mining season is limited to seven months, April to November, during which water is available. Labor is imported from Denmark. The paternal government prohibits the employment of Eskimos save in the coal mine under its own control. Formerly two-thirds of the product was sold to America (Philadelphia), but now the greater portion goes to Copenhagen by steamers which make 15 to 20 round trips during the season.

Coal outcrops in the cliffs of Disco Island and the adjacent mainland. Much of the area here is covered with basalt flows, and the extent of the coal-bearing strata (of Upper Cretaceous and Tertiary age) inland is unknown. The government mine produced 1600 tons in 1914, about half that consumed in the colony. Copper and graphite are very widely distributed but occur in no important concentrations. Locally the rare earth minerals are abundant, but the total tonnage does not promise to be sufficient for the basis of a permanent industry. Gold, silver, lead, and garnet have also been produced for exportation. The Eskimos have long made use of soapstone, pyrites, and flint, while the native iron in Disco Island basalt has been the source of an active coastwise trade.

PHYSICAL GEOGRAPHY

Bird Distribution as a Geographical Problem. In a broadly conceived study, "Die Vogelwelt als geographisches Problem," W. R. Eckardt discusses the geographical significance of bird distribution as we find it today (*Geogr. Zeitsch.*, Vol. 28, 1922, pp. 321–339). He believes that during the greater part of the Tertiary the bulk of bird population occupied an intermediate zone between the north polar regions and the subtropical deserts. The greater humidity toward the northern border of this belt made conditions particularly desirable for insectivorous species, causing a "spring" migration for the season of reproduction. The periodical but abundant food supply in the cooler latitudes led in turn to the marked multiplication which still characterizes many temperate zone species. The overpopulation which doubtless occurred at certain optimum latitudes well to the northward led to the beginning of "overshooting" (*Überwandern*). By this is meant the phenomenon that certain populous northern species migrate across the tropics, going much farther south than other species which nest in lower latitudes, in order to find in the southern hemisphere winter quarters favorable for the support of large numbers. An interesting corollary of this is the circumstance that birds breeding in low latitudes are likely to have shorter, more rounded wings than northerly geographic races of the same species.

The glacial period was therefore not responsible for the beginning of bird migration, but it extended and profoundly modified it. During the Ice Age, for example, much of the Mediterranean region of the Old World was submerged or otherwise untenantable, and the birds breeding in the north had to lengthen their winter flights. The specialization produced in bird migration is still shown in the flight routes of many European species. Thus the primitive breeding range of the stork in Germany was cut through the middle by the intrusion of the ice on a front 300 kilometers wide. On the two sides of this line of division we have today two different breeding groups of storks, one of which migrates southward via Spain and West Africa, the other by way of Palestine and the Nile Valley. In South Africa storks from both centers mingle during the winter.

Although Eckardt concludes that the zoölogical regions of Wallace are unsatisfactory when applied to avian distribution, he uses the well-known terminology for convenience. The great Palearctic region is ornithologically the poorest in the earth in proportion to its area, having but 650 *Formenkreise* (species in the Linnaean or most comprehensive sense), or one to every 1300 square geographical miles. It has, moreover, not a single endemic family although there are several peculiar genera. The general lack of endemic groups is not surprising because the Palearctic has obviously been the center of evolution for most higher birds, which have spread thence toward the periphery of the great land areas, carrying forward the latest phases of their evolution elsewhere. The paucity of endemism in the Palearctic is also due indirectly to the glacial advance, which wiped out a large flora in Western Asia and most of Europe. Because of the deserts, east-west mountain chains, and the trough of the Mediterranean there has been no good chance since the Ice Age for a repopulation of plants from the south. There are today, therefore, from five to eight times as many kinds of trees in North America and Eastern Asia as there are in Europe. Birds are most numerous toward the eastern and western extremes of Palearctica, and it is interesting to note that eastern China, before its intensive cultivation by large human populations, was the richest extratropical portion of the globe.

The Ice Age had, of course, a notable effect upon the evolution as well as the distribution of birds. White species of many kinds undoubtedly developed then. Again, the advance of the ice probably had an influence upon the development of geographic races of varying sizes because large birds radiate relatively less heat than small. The horned owl of Europe is smaller than the Siberian form, while still smaller subspecies occur in North Africa and India. The races of the raven become larger and stronger as we progress northward, and the giant among wrens is a native of Iceland.

A significant and enlightening part of Eckardt's paper is that in which he deals with the characteristic continental faunas as related to former land connections. He maintains convincingly that Asia and America can have been linked only in the north since Mesozoic time, because otherwise the avifauna of Africa and the Neotropical region could not be so strikingly distinct as we now find it. In other words, there has been no such direct connection as a South Atlantic land bridge. The northern intercontinental path was more probably restricted to a route by way of Bering Sea than by way of Greenland. In the way of land birds, the Palearctic representation in America is at best fragmentary and is Asiatic rather than European. The great faunistic resemblance which obtained up to the Ice Age has disappeared, for Eurasia has received its influx of new bird life from Africa and India, while North America has derived its repopulation from South America. Since the Pleistocene land elevation North America has in fact received little or nothing from Palearctica. This is the explanation of the remarkable differences between the eastern and western avifaunas of the northern hemisphere and of the wealth of ancient types restricted to South America.

Much of the variety of bird life in South America, at once the richest and most isolated of all the continents, is due to highly favorable ecologic conditions, especially to the amount of rainfall and the lack of extensive interior deserts. There are many endemic families of birds which show long lineage and an extraordinary number of convergences. In a sense South America has been to birds what Australia has been to mammals; many of the aberrant or rapidly radiating South American groups remind one of the extraordinary adaptive radiation of the marsupials.

With reference to Australia, its bird fauna was derived by way of the Indo-Malayan Archipelago from Asia, and the island continent has on the whole more modern types of birds than South America. It is rather curious, however, that such old and widely distributed birds as the woodpeckers have not reached Australia. The same applies to the vultures and the true finches, but the absence of the former may be attributed to the fact that the Oriental archipelago is covered either with forest or long grass. Since the finches as a group do not furnish northern species which enter the southern hemisphere as migrants, it is not surprising that they are represented in Australia by the related weavers.

Eckardt's discussion of the physiology of birds in relation to their feeding and nesting habits and his account of the rapid dispersal of certain species, accompanied by accelerated evolution in color and voice, are stimulating though sometimes rather hypothetical. He is undoubtedly correct in assuming that the song of higher birds is by no means merely a *Minnelied* but is rather a male battle cry uttered in a strictly circumscribed family feeding and breeding area, a fact brought out forcibly in Howard's recent book on "Territory in Bird Life."

Robert Cushman Murphy

Meteorology and North Atlantic Ice. Quietly and without attracting any general attention the International Ice Patrol has been faithfully performing its important duty during the past ten years. This Patrol, established by an international Convention in November, 1913, the year following the *Titanic* disaster (April 14, 1912), is maintained by the U. S. Coast Guard, the expenses being divided among the signatory Powers at the Convention in proportion to the amounts of their respective ship tonnages. The work of the Ice Patrol has two aspects, as explained by Lieut. Edward H. Smith, the officer charged with the scientific responsibilities of the undertaking ("Some Meteorological Aspects of the Ice Patrol Work in the North Atlantic," *Monthly Weather Rev.*, Vol. 50, 1922, pp. 629–631). The first and most important duty is to determine the limiting lines of dangerous ice and to disseminate the information for the guidance of shipping. The second is the making of such meteorological and oceanographical observations as may aid in determining the causes of the variations in the amount and distribution of the ice and thus lead eventually to the attainment of greater safety for life at sea.

The main source of icebergs is the glaciers on the west coast of Greenland, from about Disko northward. These bergs, on entering the Labrador Current, drift south along the east side of the Great Bank and in April, May, and June are a menace to shipping in that vicinity. A large number of factors are at work in controlling the variations in the North Atlantic ice from season to season. Among these are variations in the hydrodynamic conditions in the Arctic and the North Atlantic; seasonal changes in the general movements of the atmosphere under control of the "centers of action" over the Atlantic; and also the meteorological conditions over the northern regions during the preceding year, notably the prevailing winds over the birthplace of the bergs on the western coast of Greenland. Other factors doubtless also come into play. To investigate these various controls will require a thorough study of all available meteorological, oceanographical, and ice data for the region concerned. Unfortunately, there is a very great lack of meteorological stations functioning the year round, but such data as are available are to be studied. In connection with this investigation a year-round station on the coast of Baffin Land, e.g. at Cape Dyer, would doubtless be very valuable both as supplying much-needed meteorological data and also as making it possible to secure definite observations as to the number of bergs drifting southward. It takes about five months for a berg passing Cape Dyer to appear south of latitude 45° N. Long-range forecasting of ice conditions in the North Atlantic would probably be possible if the number of bergs and the dates of their passing Cape Dyer were known to the Ice Patrol.

R. De C. Ward

The Dayton Experiments in Fog Dispersal by Electrified Sand. Professor Wilder D Bancroft, of Cornell University, and L. Francis Warren with the aid of the U. S. Air Service have put into practice the theory of coalescing droplets by discharging electrified sand over fogs and clouds. On February 11 an Associated Press dispatch told in detail some of the results of a year and a half of successful experiments. Fine sand sprinkled from a passing airplane is said to have precipitated clouds and fogs of various thicknesses and dimensions. Eighty pounds of sand charged nominally to 15,000 volts is said to have been adequate to disperse in ten minutes a cloud covering two square miles. The particles of electrified sand gather the cloud or fog droplets into larger drops which fall faster than the original small ones. Snow flurries and light rain are said to have occurred at times. Since the investigators are scientists, it is presumed that they have made due allowance for the normal tendency of a fog or cloud to evaporate, especially when disturbed by a passing airplane. Furthermore, in ascribing the light precipitation to the action of the sand, they must have been careful to watch other clouds not so treated.

As the Air Service was concerned merely with improving the visibility, no experiments in rain making were tried. Nevertheless, with such statements as ". . . in many of the arid regions storm clouds pass over without raining. These can undoubtedly be made to rain. . . ." (Bancroft in *Sci. Serv. News Bull.*, Feb. 19, 1923), the experimenters have led the public to believe that rain making is feasible at last. It may be so in a technical sense, but is probably not so in the popular sense. As a storm cloud is formed only by rising air, any lack of rainfall from it is not to be ascribed to smallness of drops but to the strength of the upward current, which does not let them fall to earth. Dusting such a cloud, therefore, could not precipitate it. However, suppose there were no upward wind and suppose there were no evaporation of the falling drops, according to Dr. W. J. Humphreys (in an address before the April Meeting of the American Meteorological Society) the precipitation of the entire water content of a cloud a mile thick and containing 1000 droplets per cubic inch would yield only 1/1500 of an inch of rain. Our appreciable rains occur not from the precipitation of a cloud but from the continued cooling of large masses of air passing over a region.

Charles F. Brooks

GEOGRAPHICAL NEWS

The Second Pan-Pacific Science Congress. At the Australian Meeting of the British Association for the Advancement of Science, 1914, expression was given to the need of organized study of the Pacific and its problems. Subsequent meetings and informal conferences held by American institutions led to the first formal meeting for co-operative work on the Pacific, the "First Pan-Pacific Scientific Conference," held in Honolulu in 1920 under the auspices of the Pan-Pacific Union. (See Professor H. E. Gregory's Introduction to the Proceedings of the Conference, Special Publication of the Bernice P. Bishop Museum, 1921.) The second conference will be held in Australia in August and September of this year (1923) under the auspices of the Australian National Research Council. From August 13 to 22 the Congress will meet in Melbourne; from August 23 to September 3 in Sydney. The tentative list of subjects for papers and discussion thereon is given below.

A. *Agriculture and Veterinary Science*—Agriculture including soil problems, Climate in relation to crops, plant pathology, and plant breeding. Veterinary Science—Diseases of live stock in the Pacific Region; Methods of eradication and control.

B. *Anthropology and Ethnology*—Polynesian and Melanesian Races, Australian Aborigines, Totems, Languages, Folklore, Anatomy.

C. *Biology including Botany, Entomology, Zoölogy*—Botany—General plant distribution in the Pacific; Floras of Island Groups and of individual Islands. Entomology—Insects harmful to the planter and farmer; Rôle of insects in transmitting disease and the control of weed pests. Zoölogy—The distribution of animals; Fisheries.

D. *Geography and Oceanography*—Marine Currents, Continental Shelves, Charting in the Pacific.

E. *Geology*—Coral Reefs, Glaciation, Structure of the Pacific Region, Carboniferous and Permian Problem, Correlation of Cretaceous and Kainozoic Sediments in Pacific, Mineral Resources, Vulcanology, Geological Surveys.

F. *Hygiene and Climatology*—Mining Hygiene, Ventilation, Dust Prevention. Tropical Diseases: hookworm, malaria. Climate in its relation to human efficiency.

G. *Physics*—Including Geodesy, Geophysics, Radiotelegraphy, Seismology, Isostasy, arc of meridian in Australia, longitude by wireless, weather cycles, and weather forecasting.

Reference may also be made here to the interesting statement of problems issued by the Royal Academy of Sciences of Amsterdam through its International Circumpacific Research Committee. The Committee is also publishing a series of brochures on "The History and Present State of Scientific Research in the Dutch East Indies."

The National Research Council, the Geological Society of America, and several other American institutions are sending delegates to the Congress. The American Geographical Society will be represented by Mr. Alfred H. Brooks and Dr. Nevin M. Fenneman.

Bio-Bibliography of Alfred Grandidier. In the "Notice historique sur Alfred Grandidier," read before the French Academy of Sciences, December, 1922, Alfred Lacroix pays tribute to the memory of his distinguished colleague, who died in Paris, September, 1921, in his eighty-fifth year.

Alfred Grandidier's name is indissolubly connected with Madagascar. Since his first chance visit in 1865 to this then "unknown" spot he devoted himself with absolute singleness of purpose to elucidating our knowledge of the island, its resources, and inhabitants. To its cartography, natural history, history, ethnography he made notable contributions and inspired others to further study. After several years spent in traveling in various parts of the island, surveying and collecting, Grandidier commenced work on the monumental "Histoire physique, naturelle et politique de Madagascar," designed to occupy 60 volumes. He himself wrote the introductory volume; for the volumes on natural history he found collaborators; while his son Guillaume, now secretary of the Paris Geographical Society and editor of *La Géographie*, who follows his father's interest in Madagascar (see his article on Madagascar in the *Geogr. Rev.*, Vol. 10, 1920, pp. 197–222) was his collaborator on the ethnographical side. As a complement to this work Grandidier undertook the publication of a "Collection des ouvrages anciens concernant Madagascar."

Grandidier's work was no small contribution towards the successful incorporation of Madagascar in the French Colonial Empire, a fact that has been recognized by his grateful country.

The "Bibliographie Géographique" and Two Other Bibliographical Aids of Value to the Geographer. Geographers the world over welcomed the appearance somewhat over a year ago of the *Bibliographie Géographique*, Vol. 25–29, covering the years 1915–1919 (Armand Colin, Paris, 1921) and in April of the present year of Vol. 30–31 of the same publication covering the years 1920–1921 (Paris, 1923)—both volumes edited under the direction of Elicio Colin. These volumes are a continuation of the *Bibliographie Géographique Annuelle* (of the *Annales de Géographie*) long edited by Louis Raveneau and justly regarded since its inception in 1891 as a fundamental instrument of geographical research. The World War, however, forced suspension of publication after the volume for 1913–1914 had appeared in 1915. Though useful geographical bibliographies were published in connection with the *Rivista Geografica Italiana*, the *Geographical Journal*, and in the admirably full bibliographical section of *La Géographie*, none of these could take the place of the bibliography of the *Annales de Géographie* in comprehensiveness of scope, in convenience of arrangement, or in the critical acumen which lay behind the selection and characterization of the items included. Primarily in order that financial backing might be found for the resumption of the bibliography, the Association de Géographes Français—a French counterpart of our Association of American Geographers—was founded, and hence the two new volumes to which attention is now especially directed were not produced in connection with the *Annales* but under the auspices of the Association.

The new volumes fully maintain the high standard of the earlier numbers of the series. The selection of material has been broad but critical. In the volume for 1915–1919 there are 1931 numbered titles: in that for 1920–1921, only ten fewer. These figures, however, do not by any means represent the total number of references. These must be easily twice as many, for many of the numbered titles—normally representing the works of a single author—are followed by lettered items, and in many of the critical notes a wealth of minor citations is given. The majority of the references are to publications of societies, scientific and scholarly periodicals, government documents, and books which present the results of mature research or constructive thought. To take, for instance, the part devoted to the United States, we find that the majority of the references are to such periodicals as the *Annals of the Association of American Geographers*, the *Journal of Geology*, the *Monthly Weather Review*, the *Geographical Review*, the *Scottish Geographical Magazine*, the *Engineering News Record*, the *Annales de Géographie*, and others of equivalent scientific standing. Several pages are also given to the publications of the various departments of the United States Government, but only the publications of unquestioned geographical interest are mentioned. Out of a total of some sixty-odd major references on the United States, only ten are to books produced by commercial publishing houses. The purely popular book of personal impressions, unless it makes some genuine contribution to geographical knowledge, finds no place in the *Bibliographie Géographique*. On the other hand, language seems to have been no obstacle to the compilers, and it is somewhat tantalizing to the average, non-Slavonic-reading American geographer to see the number of works referred to in Russian and other eastern European tongues.

The scheme for the arrangement of the materials was worked out when the *Bibliographie* was begun in the early nineties, and with slight modifications it has remained the same ever since. The aim has consistently been to bring together materials which the geographer would wish to find together. There are two main parts, general and regional, each divided into carefully defined subdivisions. There is nothing complicated about it. Unlike some of the bibliographical products of German scholarship—helpful only after one has given time and study to their intricate structure—the organization of the material of the *Bibliographie Géographique* is transparently clear, simple, and logical: to be understood from a glance at the analytical table of contents at the end of each volume. Furthermore, numerous cross references both to the current and former numbers of the *Bibliographie* enable the student to trace out any subject in all its ramifications.

The signed critical comments on the various references form one of the most useful features of the *Bibliographie*. Where an individual work deserves especial praise or censure, this is given in a few well-selected words. The main value of the comments lies, however, in the fact that, brief as they are, they furnish the student with facilities for placing each work in its relation to earlier and contemporary investigations in the same field. This is done sometimes by references to important reviews of the work or to other works on the same topic, but frequently by a short discussion of the topic itself and of the contribution which the particular item under consideration has made toward its development.

In addition to the *Bibliographie Géographique*, two other recent bibliographical books of wider scope may well be brought to the attention of geographers. The first of these is Réné Maunier: Manuel Bibliographique des sciences sociales et économiques, Paris, 1920, in which are listed, often with brief comments, bibliographies dealing not only with matters of exclusively sociological and economic interest but with various geographical aspects of these subjects: materials of vital importance to the student of human geography on agriculture, industry, transportation, commerce, and colonies. The second is I. G. Mudge: New Guide to Reference Books, Chicago, 1923, based upon the third edition of the well-known "Guide to the Study and Use of Reference Books," by A. B. Kroeger. This is a volume which will go far toward enabling the geographer to make the most efficient possible use of the great libraries of this country.

GEOGRAPHICAL REVIEWS

Viscount Bryce's Last Book

James Bryce. **Memories of Travel.** xi and 300 pp. The Macmillan Co., New York, 1923. 9 x 6 inches.

Few men have been better equipped than the late Viscount Bryce to capture the *genius loci* lacking which the description of a region is of the dead body without the spirit. Few men have had a broader background of natural science or of understanding of mankind. Lord Bryce's skill in analyzing and interpreting human institutions is too well known to require comment. Suffice it to remark that the brief sketches of life found in his last book, "Memories of Travel," are fully characteristic of the deep insight into human problems so markedly manifested in "The American Commonwealth" and "Modern Democracies."

"Memories of Travel," however, is primarily important for what it reveals of another phase of Lord Bryce's almost universal interests. Few men possessed a more highly developed geographical instinct than he, or a more burning love of the forms and aspects of the land. It was this instinct, quite as much as the athletic or sporting spirit, which fed his unquenchable mountaineering ardor and gave to his published accounts of mountain climbs a value far above that of the average narrative of perilous feats among rocks and glaciers. It was also this instinct which impelled him to visit nearly every part of the world at some period in his life and to observe and record unerringly the appearance of landscape and the character of people. Some of his journeys were described in such well-known volumes as "Transcaucasia and Ararat," "Impressions of South Africa," and "South America: Observations and Impressions." It was his intention to publish another work on other journeys both on and off the beaten path. Had this been possible, we should now possess in the writings of Bryce something unique in geographical literature, a collection of studies of all the major regions of the world written from first-hand observation by an unusually gifted and competent observer.

"Memories of Travel" represents but a fragmentary portion of the greater work which Bryce contemplated, but it is, none the less, remarkable in breadth of scope. In three hundred all too short pages we are carried to the wastes of Iceland, to the crags of the Carpathian highlands, to the ruins and battle fields of Palestine "hallowed by traditions—all bathed in an atmosphere of legend and marvel," to the isles of the Southern Pacific, to the broad expanses of American scenery, and to the remote uplands of the Altai, untouched by civilization. Lord Bryce's gift of description, as revealed in all of these essays, is of that remarkable quality which makes the scenes he describes linger long in the memory almost as if the reader had himself looked upon them. This is not accomplished by any elaboration of phraseology but by a style so clear and simple and informal that one forgets the words and sees only the picture behind them. Two quotations will suffice to illustrate his power of picking out those essential elements of form and color in landscape which strike the mind but which less gifted writers often fail to discern through the confusion of detail. "Bare, undulating flats of bog or stone, traversed by foaming rivers, and backed by wild, irregular, isolated mountains, sometimes snow-covered, sometimes black and rugged—such are the general elements of an Icelandic view, and it needs all the vivid brilliance of the air, and the dignity which vast extent gives, to redeem them from dreariness and monotony" (p. 9). Or, to take a scene of entirely different character in the Pacific: "On one side the flowing purple of the sea, flowering into white when the breeze catches the wave crest, on the other the mountain spires, between the deep green of the trees, with their heads of red or yellow blossom. It is a landscape almost too perfect" (p. 223).

Americans will read with especial interest the chapter on the scenery of North America, written during the last year of Bryce's life. Though the appreciation of beauty in landscape is largely a subjective matter, it is probably true that those of us who are not too much blinded by false patriotism will feel that Lord Bryce's observations are fundamentally just. He points out that "everything in America is on a great scale" and that "this vast scale gives a large number of places in which such beauty as rivers and mountains display can be enjoyed, but it does not necessarily make more beauty." He does not lavish praise on the grandeur of our mountains. On the contrary he asserts that the uniformity of elevation in the Rockies and Sierras "and the absence of striking forms" make these groups "less interesting to the climber or painter than might be expected from their height, while the dryness of the climate prevents accumulations of snow sufficient to feed glaciers. Few have forms sufficiently noble and peculiar to give them individuality" (pp. 230–231). On the other hand, there are no more striking passages in the entire volume than those in which the author gave expression to the deep feeling stirred within him by the brilliant autumnal colors of our eastern forests, by the sunset over the desert, and by the Grand Canyon of the Colorado. "Why this deep hole in the ground should inspire more wonder and awe than the loftiest snow mountain or the grandest waterfall I will not attempt to explain, but it does" (p. 248).

Scenery and Life in Western Europe

M. I. Newbigin. **Frequented Ways: A General Survey of the Land Forms, Climates, and Vegetation of Western Europe, Considered in Their Relation to the Life of Man; Including a Detailed Study of Some Typical Regions.** xi and 321 pp.; maps, ills., bibliogrs., index. Houghton Mifflin Co., Boston and New York, 1922. $3.50. 9 x 6 inches.

The volume deals with Western Europe, its land forms, climate, and vegetation, in relation to the life of man. The author in her preface designates her work as intended for the interested traveler, rather than the geographer in the technical sense. She hopes that "something of joy of intensive travel shines through the pages." This purpose she has attained in high degree; indeed, her wide learning and keen observation nowhere disguise her admirable and broadly human appreciation of all that she sets forth. She beguiles the traveler into classic fields where nature has done much and where man and nature have wrought on each other. Many questions are answered with keen insight; and many queries are aroused for the challenge of thought and, at least for an American student, for comparative application on the western side of the big salt water.

Europe is seen as before the war, but this marks no defect, since it was no part of the author's plan to include political units in her discussions. The fruits of European travel have by no means all been harvested, though long-distance globe trotting now seems the only worthy goal of some. Glaciers and glaciation, the fires of Vesuvius, the cold lavas of Britain, Auvergne, and the Eifel, the whole gamut of temperate climate, and the glory of young mountain folds, are all more available within twenty-four hours of London, than they are in America, Australia, or the two greater land masses of the old world. The "infinite variety of Europe" is virtually the author's theme, expounded on general geographic lines in the twelve chapters of Part I; while a selection of special and typical regions occupies Part II, Chapters XIII to XXII.

The author is inclined to put the real Europe, the Europe that "looks west," on this side of the meridian of the western end of the Black Sea and to include in it the whole Mediterranean seaboard. The basal elements of structure are explained, as determining the course of great routes to the south and as evolving in certain types of scenery.

More than by most geographers, and doubtless reflecting Dr. Newbigin's special training and interests, the floras are stressed in chapters on "The Plant and its Home," "Myrtle and Bay," "Meadow, Wood, and Pasture in the Alps," and "Moors and Heaths."

The industrial revolution, with the growth of transportation, has brought vast changes in the adjustment of products to environment. Such problems are freshly illustrated in Chapters XI and XII, in which some geographers may find their focus of interest in the entire volume.

Dr. Newbigin has put little system into her volume, and little was needed. It may be profitably read from cover to cover, and it may well be picked up in fragments. An index and discriminating references at the end of each chapter blaze the road to further study. But the apparatus of research is no menace to the general reader, whose best use is to dip and ramble in a volume which, designed for him, uses scientific facts daringly and without pedantry.

Albert Perry Brigham

Man and Nature in Central Arabia

H. St. J. B. Philby. **The Heart of Arabia: A Record of Travel & Exploration.** Vol. 1, xxiii and 386 pp.; map, ills.; Vol. 2, vii and 354 pp.; maps, ills., glossary, index. Constable & Co., Ltd., London, 1922. 9 x 6 inches.

The attention of readers of the *Geographical Review* has already been directed to Philby's explorations in Arabia in 1917–1918. In an article by D. G. Hogarth ("Some Recent Arabian Explorations," *Geogr. Rev.*, Vol. 11, 1921, pp. 334–337) there was given a succinct account of his remarkable expedition across the peninsula in the winter of 1917 and of his journey of three hundred miles southwestward from Riadh to Wadi Dawasir and back during the following summer. The outstanding results of the latter journey were also stated in an earlier note (Vol. 10, 1920, p. 347). In the present review, therefore, no attempt will be made to repeat what has already been said in these places about the more strictly geographical aspects of Philby's work.

The two volumes now under consideration contain a complete narrative of the crossing of Arabia. The account of the wanderings of 1918, however, breaks off upon Philby's return to the Wahabi capital from southern Nejd. It is a pity that circumstances did not permit the author to tell of his subsequent adventures and of the part he took in Ibn Sa'ud's campaign against Haïl.

Philby's book is the first full and satisfactory account of nature and man in a region about which, prior to his travels, Western knowledge had been of the vaguest and most confusing sort. Much of this region had never before been seen by Western eyes. Other parts, though discussed by Palgrave and possibly visited by him (Mr. Philby doubts that he visited them) were described in such misleading and contradictory terms as to be wholly incomprehensible. It is a fortunate circumstance, therefore, that Philby was endowed with keen powers of observation and a thorough knowledge of the Arabic language. It is perhaps even more fortunate that through his official position as representative of Great Britain he was received with favor by Ibn Sa'ud, the ruler of Nejd, and Al Hasa, under whose protection he traveled, and that the peaceful conditions established by Ibn Sa'ud's strong hand enabled him to traverse, unmolested, districts that would have been totally inaccessible not many years earlier. Philby made the most of his opportunities; and his book, consequently, is if anything more notable for the picture it paints of Arabian character and customs than for the new light it sheds upon the geography and topography of the Arabian peninsula. In this respect "The Heart of Arabia" can stand comparison with Doughty's all-too-little-read but none the less immortal "Travels in Arabia Deserta." But far different were the conditions of Philby's wanderings from those of his great predecessor in the tracts lying northward and westward. Where Doughty, the penniless outcast and despised "Nasrani," sought, sometimes vainly, the humble hospitality of the Bedouin, Philby was enabled to establish cordial and often familiar relations with the ameers and other local representatives of Ibn Sa'ud. Not that tense moments were lacking, as when the explorer and his party "marched in grim silence along the southern wall" of the town of Dam in Wadi Dawasir "under the sullen glare of its assembled people, knowing that the cry of a single fanatic or a madman's shot might precipitate a crisis in face of which, commanded as we were by every roof, we should have been powerless" (Vol. 2, p. 190). But such moments were rare, and for the most part events went along smoothly enough.

The extraordinary interest of the interior of Arabia lies largely in the fact that here is to be found one of the few remaining parts of the world where there still exists at the present time a strongly centralized and capably administered state virtually untouched by Western civilization. Here are no railroads, telegraphs, nor electric lights; neither is there democracy nor communism nor even the desire of such. We step back into a good old Oriental despotism ruled by the personal force of one man. The despot in the case, Ibn Sa'ud, is not only a man of iron but a personality of exceptional magnetism and a remarkably astute politician. An example of his skilful manipulation of the religious fanaticism of his realm to serve the ends of statecraft is furnished in his organization of the *Ikhwan*, or "Brothers," created only about ten years ago. This "new freemasonry" which "has in the course of the decade transformed the character of Badawin society and caused a flutter of anxiety throughout Arabia" is "nothing but a Wahabi revival in an intensified form." By the establishment of colonies of *Ikhwan* fanatically devoted to his interests in all parts of his territories Ibn Sa'ud has been able to bring peace and order to wide tracts where formerly there reigned incessant robbery, bloodshed, and petty warfare.

How long this peace and security will last, how long the successors of Ibn Sa'ud may be able to hold together a people who, through dispersal and fragmentation in oases scattered far and wide in the midst of deserts and steppes, are incessantly played upon by the disruptive forces of nature and of inclination—these are problems that Philby assures us lay heavy on Ibn Sa'ud's mind.

It is difficult to refrain from writing at length of some of the many lesser details treated in these volumes: the comments on the Puritanical austerity of the Wahabis; the brilliant picture of the army of Ibn Sa'ud on the march, like a medieval host with myriad of fluttering banners; the description of the town of Riadh, with its severely unornamented architecture, and of other settlements and oases; the sympathetic sketches of Arab character and the multitude of human touches. An amusing account of the difficulties experienced by Philby's escort as they drew near Mecca in determining the direction of the Holy City in order that prayers might be properly oriented—a matter of vast moment in the practice of Islam—will appeal to the humor of the geographically minded. The student of geographical nomenclature will find much in the illuminating discussions of Arab usage regarding place and regional names and their adaptation to the physiographic features of the country. The descriptions of the land forms are usually clear, even though obviously not the work of a trained physiographer. Each of these points and many more besides well deserve more extended comment.

Especially noteworthy, however, are the data which Philby gathered from a native of those parts regarding the great southern desert, or Empty Quarter. Of all Europeans Philby approached the nearest to the northern border of this immense tract, probably the largest expanse of unknown land in the world outside the Antarctic continent. As frequently happens under similar circumstances, more detailed knowledge of the Empty Quarter leads Philby to believe that it is not so terribly barren as had hitherto been supposed. The tribe of Al Murra manage to eke a precarious living from its surface. These are a primitive folk, only recent adherents of Islam, who "lead a life as lean and wild as anything one can imagine." In a vast sandy tract of Khiran within their confines the Al Murra tell of a buried city frequented by *Jinns* or ghosts to be "heard of a windy night moaning piteously over the fate that has overtaken the scene of their lives. . . . It must indeed be an eerie spot, that dead city of the past far away from human ken, and may be the salty pools about it are all that is left of a great oasis of those times before the sand swept over the face of Southern Arabia."

Philby's exceptionally vivid and distinguished style is marred only by the tendency to make use of excessively long sentences. Were it not for this minor defect we should be tempted to class "The Heart of Arabia" with Doughty's "Travels in Arabia Deserta," Borrow's "Bible in Spain," and some of the writings of W. H. Hudson: among the few books that stand apart by themselves as masterpieces of English travel literature.

The Story of Long Island

R. H. Gabriel. **The Evolution of Long Island: A Story of Land and Sea.** 194 pp.; map, bibliogr., index. (Yale Hist. Publs., Miscellany IX.) Yale University Press, New Haven; Humphrey Milford, Oxford University Press, London, 1921. 9 x 6 inches.

The purpose of this essay is "to trace the development of a people as it has been affected not only by its social and economic but by its natural surroundings." In the evolution of Long Island the author sees an unfinished play—a game between two mighty forces, the ocean and the hinterland.

A brief sketch of the historical geology and physiography of Long Island lays the scene for the drama. The reader regrets a little that no physiographic map of the island is included, as for reference such a map is superior to the best description (the only illustration is an outline map on the scale 1:700,000). Given the environment, we are ready to visualize the life of the early settlers, most of them pioneer farmers who labored "only to get bread and clothing, without hopes of ever seeing a penny of monies." Interest in scientific agriculture awoke when improved transportation made Long Island feel sharply the competition of the great virgin lands of the West. This competition of the hinterland later forced the Long Island farmer to change from general farming to dairying and truck gardening.

Turning to the ocean, we follow successively the rise and decline of the whaling industry of the eastern harbors, the development of the menhaden fishery to supply cheap fertilizer, and its final concentration in the hands of a syndicate (cf. the author's "Geographic Influences in the Development of the Menhaden Fishery on the Eastern Coast of the United States," *Geogr. Rev.*, Vol. 10, 1920, pp. 91–100). Oyster fishing in Great South Bay exhibited a similar transition from the day of the bayman in an open rowboat equipped merely with long-handled rakes to the period of oyster planting and the steamer and dredge. As scallop beds will not remain stationary and so cannot be leased and controlled by large companies, scalloping in Peconic Bay is still carried out by individual fishermen.

Before the time of railroad building, turnpikes and coastwise sailing vessels competed for the carrying trade of Long Island. The isolation of the eastern villages around Peconic Bay gave them an excellent opportunity for smuggling and even piracy. They persisted in illicit trade with Boston and in evasion of duties to the despair of the governors of New York. It is worth noting that, later, Long Island for a short time afforded the easiest route between New York and Boston; indeed, the first line of the Long Island Railroad was built to connect with a ferry from Greenport to Stonington whence one might complete the journey to Boston by rail, making the entire trip from New York in "only eleven hours and a half." The great development of Long Island as a summer resort for the people of New York was advanced not only by the railroad but also by the coming of the highway, the bicycle, and the automobile. In the evolution of the island the sea has stimulated the variations, or the appearance of new vocations, and the hinterland has acted as the selective factor, determining which variations should survive.

This essay should be read by all who desire to gain from one significant example some comprehension of the typical trend of American agriculture and coast industries in the northeast. The clear and graceful style of the writer and his vivid descriptions of the farmer, fisherman, and adventurer of the past make his book an attractive and entertaining, as well as profitable, study.

ELEANOR S. BROOKS

A STUDY OF SEA INFLUENCE IN AMERICAN LIFE

S. E. MORISON. **The Maritime History of Massachusetts, 1783–1860.** xviii and 401 pp.; maps, ills., bibliogr., index. Houghton Mifflin Co., Boston and New York, 1921. $5.00. 9 x 6½ inches.

Far back in the seventeenth century, English men and women, crossing the little-known Atlantic in tiny ships, established themselves along the seaboard of the western continent—the first American frontier. For more than two centuries and a half, the British colonies and then the United States knew a frontier facing the open country that lay to the westward. But all the conditions of the first frontier were never repeated in those that followed. To be sure, it, like all the rest, was bounded on the west by untamed lands; but, on the east, instead of villages and cities and settled farms, lay the ocean. These shore-dwelling first pioneers heard alike the call of the land and the sea. Their early answers to these two influences laid the foundations for both the land life and the sea life of the American people. As time went on and the land frontier pushed westward, the sea frontier was pushed eastward and southward until it encircled the globe; and the qualities demanded of the men in the cabins of the ships were little different from those required in the cabin homes of the forest.

Then there came a time in our history when our people abandoned the sea and we became so engrossed in the building of railroads and factories that the old packets and clipper ships were all but forgotten. But now that we have reared a mighty industrial structure, we are reviving the memories of those bygone days when American ships and sailormen knew every sea lane of the great commercial oceans. Professor Samuel Eliot Morison's "Maritime History of Massachusetts, 1783–1860," is the best of the true stories of the sea that this awakened interest has brought out. It is, by all standards, a good book. Massachusetts, through every phase of whose history, save the last, "blows the east wind," is chosen for the setting. "Nature seemed to doom Massachusetts to insignificance; to support perhaps a line of poor fishing stations and hardscrabble farms, half-starved between the two hungry mouths of Hudson and St. Lawrence. Man and a rugged faith have made her what she is." Then the story is told from the first frontier beginnings to the end.

There is little philosophy in the book; the reader, for the most part, is left to draw his own conclusions. But it is full of suggestive material for the student interested in the influence of the natural environment on the development of men. And here and there are striking interpretations. Perhaps the best of these is the explanation of why the seafaring people of Massachusetts and New England were so bitterly opposed to the War of 1812 as to be seriously discussing secession in 1814. "They that do business in great waters have little in common with their land-plodding countrymen. Their native land is but a resting place between voyages; a wharf and shipyard and cottage by the sea. . . . The Union ceased to be valuable when fresh-water politicians took bread from the mouths of honest seamen." It must be admitted that there is little sympathy for the point of view of the Jeffersonian landlubber. In fact, one puts down the book with the feeling that New England Federalism, with all its fine qualities and all its austerity and aloofness, is not yet quite dead. But the part played by the sea in shaping the Federalist attitude is set forth as never before.

The book makes vivid a phase of American life which was of the greatest significance in out national life and one which seems to have passed almost completely out of our national consciousness. The language as well as the atmosphere of the sailing ship pervades the pages. The whole story is there—the trading ships, the fishing smacks, the whalers, and the episode of the California gold rush—all set off with well-chosen illustrations. There is an extensive and useful bibliography which omits, however, mention of Ralph Paine's "The Old Merchant Marine," a book which as much as this makes the old maritime spirit of New England live again. A German monograph by Hans Keiler, "American Shipping, Its History and Economic Conditions," useful though dull, has also been omitted.

One concluding note sums up much of the influence which the sea has had in shaping American life. "Never, in these United States, has the brain of man conceived or the hand of man fashioned, so perfect a thing as the clipper ship. In her the long-suppressed artistic impulse of a practical, hard-worked race burst into flower. The *Flying Cloud* was our Rheims, the *Sovereign of the Seas* our Parthenon, the *Lightning* our Amiens; but they were monuments carved from snow. For a brief moment of time they flashed their splendor around the world, then disappeared with the sudden completeness of the wild pigeon."

Ralph H. Gabriel

The Wood-Forbes Report on the Philippines

Report of the Special Mission of Investigation to the Philippine Islands, *House of Representatives Doc. No. 398, 67th Congr., 2nd Sess.* (*Rept. of the Governor General of the Philippine Islands, January 1 to December 31, 1921*), pp. 13-43. Washington, D. C., 1922.

This report, which is better known as the Wood-Forbes Report as published, is a very brief summary of 31 pages only. The bulk of the report—which, as far as the reviewer knows, has not been published—is contained in the voluminous "Exhibits." These contain much information of a confidential nature and are not generally accessible to the public. This survey in its entirety is perhaps the most exhaustive and searching inventory of a country and its people ever made in so short a time by another people.

The personnel of this special Mission included two of the foremost names ever connected with American Insular affairs. The chairman, Major General Leonard Wood, U. S. A., retired, now Governor General, of course needs no introduction since, besides his distinguished army record, he was said by Lord Cromer to be the only person qualified to "carry on" his own great work in Egypt, an estimate he has eminently justified in his last year and a half as a civil administrator in the Philippines. The second member of the Commission, Hon. W. Cameron Forbes, owing to his long service in the Philippines where he earned the sobriquet "The Road Builder," proved a strong collaborator. An especially able staff and a small army of co-workers, both American and Filipino, aided in the arduous work of this most intensive and extensive survey. In spite of the general disagreement with the findings of the report on the part of the leading Filipino statesmen, no one has been able to prove that it was unfair or in error.

In a short note of this kind it is impossible to call attention to more than a few outstanding results, and only those of especial interest to geographers will be noted here.

On page 20 the statement is made on the authority of Professor H. O. Beyer, it is presumed, since he was attached to the Mission and is the leading authority in ethnological matters in the Philippines, "there are eight languages in the islands, each of which is used by not less than 500,000 people, and some seventy-odd more which are used by smaller groups. Some differences between their dialects are slight enough so that people using different ones can make themselves understood, but many are so radically different that they are mutually unintelligible." These facts coupled with the lack of ready facilities for intercommunication are the chief factors tending to work against the solidarity of the people. As the report shows, these difficulties are being rapidly lessened.

The general land situation—and this of course is the foundation for any sound economic structure of a country—was found to be in a serious condition. The abolition of the Court of Land Registration was a serious mistake. Governor Wood is now taking steps to reëstablish it.

The teaching of English in the lower grades of the schools is one of the few points on which the reviewer would take issue with the report and with our whole Governmental policy. Unless several thousand American teachers could be employed over there it would seem to be sounder policy to follow the methods of the Dutch in this respect. On this point the reviewer is well aware that he is in the minority and that most Americans would agree with the Mission.

Very pertinent is it that attention is called to the deterioration in the Bureau of Science previous to the incumbency of the present director, Mr. Merrill. The Bureau was formerly the leading tropical research institution in the world and, under the able administration of the late Dr. Paul C. Freer, was in some ways America's greatest single achievement in the Far East. The deterioration noted, it should be said, was not due entirely to lack of Filipino support.

When we come to that part of the report dealing with the economic conditions of the islands we must pause for more than a passing scrutiny, for herein are disclosed some facts which have caused many of the more far-seeing leaders of the people seriously to reflect upon the advisability of immediately cutting adrift from the United States. A few of the salient facts are:

1. The advance in rate of taxation, 124 per cent, since the Filipinos were given greater control over their own government.
2. The low per capita taxation due to the United States shouldering all military and naval expenses for the defense of the islands.
3. The failure of various national business projects.
4. The costly experiments made by the Philippine National Bank.

With reference to the investments in sugar, the reviewer believes that these operations on the part of the bank will redound ultimately to the credit of the Government, and he is not in entire agreement with the report in this particular. The sugar industry, for long a very crude and primitive business, promises to be one of the greatest revenue producers and one of the most lucrative projects in the archipelago and a formidable rival of the industries of Hawaii and Cuba.

On the next to the last page of the report of the Mission, among some twelve specific conclusions, this, perhaps the most important of all, is found: "We find that the people are not organized economically or from the standpoint of national defense to maintain an independent government." This is the crux of the whole matter—if this conclusion is correct, then a reasonable postponement of the granting of complete independence is the only honorable course open to the United States.

The all-important geographic factors involved in the strategic position of the Philippines—lying, as they do, athwart the entrance to the great all-water world way from the Pacific to the Atlantic, the character of her neighbors, her not inconsiderable latent natural resources as a temptation to unscrupulous nations, and the explosive nature of the various elements in the Far Eastern situation generally have received scant mention in the report, though they may be considered in the exhibits. To the reviewer these geographic factors seem of far greater importance than the internal condition of the islands, and, while he highly respects the aspirations of the Filipino people, he would urge their native leaders to give the geographic factors the most profound thought before committing themselves hastily to a step which might be irretrievable.

Warren D. Smith

LIFE OF THE GLACIAL PERIOD IN NORTH AMERICA

F. C. BAKER. **The Life of the Pleistocene or Glacial Period.** xiv and 476 pp.; maps, diagrs., ills., bibliogr., index. *Univ. of Ill. Bull. No. 41* (*Contrib. from the Museum of Nat. Hist. No. 7*). Urbana, 1920. $5. 10½ x 7 inches.

This volume is the outgrowth of a detailed study of the succession of biota found in the sediments of the bed of the glacial Lake Chicago. The results of this study are presented in two chapters, which follow a brief historical review of the records of life in this glacial lake bed. Advantage was taken of the geological evidence of changes of environment to which the animal and vegetable life was subjected, or in other words to ecological conditions; and the study illustrates the value of ecology in the interpretation of the variations in the fresh-water life here found.

The succession revealed by these studies may be summarily stated as follows:

1. The highest, or Glenwood, stage of Lake Chicago, 55–60 feet above the present level of Lake Michigan. Waters were cold, and life had not yet entered or was very sparingly represented.

2. A low-water stage, the Bowmanville, estimated to have been only 10 feet above Lake Michigan level. At this time a protected bay in the vicinity of Bowmanville, north of Chicago, carried a fauna of swamp and shallow-water forms of life with such snails as *Galba*, *Planorbis*, and *Physa*. The trees along the shore indicating the persistence of cold climate, embraced spruce, tamarack, fir, and arbor vitae, now found in districts considerably farther north. The cause for this low stage is suggested to be the opening of an eastward outlet past Syracuse, N. Y., at the time of Lake Wayne, of the Huron-Erie basin. This would imply a sufficient recession of the ice border to permit a passage by the Straits of Mackinac from the Michigan to the Huron basin. It also calls for an undemonstrated differential uplift of the Lake Wayne area.

3. The Calumet stage of Lake Chicago, 35–40 feet above Lake Michigan level. Above the muck beds and swamp fauna of the low-water stage a bed of sand and gravel was laid down, and there developed a large fauna of mussels of species that now inhabit our large rivers, "indicating that the bay was more open and subject to some wave action." It is suggested that these naiades were brought to this habitat by the aid of fish, in the glochidial stage, and liberated from the cysts when the fish reached this bay. This stage of Lake Chicago, it is suggested, may correlate with Lake Warren of the Huron-Erie basin, a lake which discharged into Lake Chicago through the Grand River outlet. The Tolleston stage of Lake Chicago is thought to have directly followed the Calumet stage by a lowering of the outlet through the Des Plaines valley.

4. A second low-water stage, unnamed, is characterized by the absence of the river type of naiades and a return to the fresh-water pulmonates of the swamp and shallow pond types. This is suggested to have as its correlative the Kirkfield stage of Lake Algonquin, but in the reviewer's opinion it may have begun at the time of Lake Lundy and covered the time to the uplift that brought Algonquin waters up to their full height in the southern end of the Lake Michigan basin.

5. The Hammond (or high-water stage of Lake Algonquin), 20 feet above Lake Michigan level, at Chicago. At this time a silty sand was laid down on the earlier deposits, and in this are preserved a few cyclads and gill-bearing gastropods and some fresh-water pulmonates.

6. A third low-water stage, unnamed, in which the lake bed of the prolific area north of Chicago may have become a land surface, is strikingly indicated by the presence of crawfish burrows, which are covered by succeeding lake deposits. This is thought to correlate with the opening of the North Bay outlet eastward from Georgian Bay to the Ottawa valley, in the early part of the Nipissing-Great Lakes stage.

7. The Englewood, or high-water stage of the Nipissing-Great Lakes, 12 feet above Lake Michigan level. This stage indicates a shallow bay, inhabited by a few cyclads, gill-bearing gastropods, and fresh-water pulmonates.

8. The present stage, which is a land surface with a few small ponds and swampy streamlets. The deposits and organic growths of this stage are ordinarily confined to the upper foot or two, largely classed as soil.

Having presented the results of this detailed study of the life in the bed of Lake Chicago, the author devotes a chapter to the postglacial biota of the entire Great Lakes region, beginning with the proglacial lakes in each of the lake basins. Interesting data are presented as to the percentage of living and extinct species. Of 68 plant species and 271 animal species represented in the deposits overlying the Wisconsin drift, only 2 plant species and 29 animal species are extinct. Among the animals, the mollusks have 231 living and 7 extinct, while the insects have 3 living and 7 extinct, and the mammals have 8 living and 13 extinct species. Of the mammals the Megalonyx, peccary, extinct musk ox and bison, mastodon, two mammoths, two extinct elk, an extinct caribou, and the giant beaver lived and roamed the territory long after the ice had entirely disappeared from the Great Lakes region.

The author then attempts to bring together the available data on the remains of life found in the oldest drift and in each of the interglacial deposits, as well as that imbedded in the tills. This represents a vast amount of reading and considerable reflection. In many cases in which remains of plants or animals have been found the precise geological horizon is uncertain. The present volume, in the reviewer's opinion, is open to the criticism of giving too definite an assignment of the geological horizon in many cases. There are at least a score of places in which the reviewer is certain that the wrong geological horizon is assigned, and as many more where there is uncertainty of the correctness.

There are also a number of incorrect items of correlation and of explanation in reference to the history of some of the glacial lakes, which will make it important for the reader to consult the papers or reports cited. Thus on page 112, in discussing Lake Arkona, it is stated: "For some reason, not yet well understood, the lake waters were drawn down to a much lower level." It is really well understood that this lowering was due to the recession of the ice border from the "Thumb" of Michigan, thus allowing Lake Maumee to become confluent with Lake Saginaw and be drawn down to its level. It is also incorrectly stated that there was a similar lowering in the Michigan basin. On the same page the Ubly outlet is given as an outlet of Lake Maumee, whereas it was the outlet of Lake Whittlesey.

There are also certain ideas presented that are out of date and inconsistent with later publications. Thus the idea that Lake Erie started as a small body of water in the eastern end of the basin (p. 86) is opposed by the evidence brought out by Leverett in *U. S. Geol. Survey Monograph 41* that differential uplift only affects the eastern end of the basin. The main fluctuations in its level are due to the great changes its drainage area has sustained. It is now in a flooded state because the three upper lakes have had their drainage diverted into it by uplift of the North Bay outlet. The map of preglacial drainage in the Great Lakes region (Pl. 54), taken from J. W. Spencer, is out of date for the Huron and Michigan basins, as may be seen by reference to Plate 2 of *U. S. Geol. Survey Monograph 53*, in which it is shown that there was preglacial drainage westward from Saginaw Bay to the Lake Michigan basin.

The faults and errors pertain as a rule only to matters indirectly related to the subject under discussion and in but few cases are likely to be misleading. The volume as a whole is a painstaking and thorough piece of work.

Frank Leverett

A Study in Regional Physiography

C. A. Malott. **The Physiography of Indiana.** Maps, diagrs., ills. Separate of Handbook of Indiana Geology, Part II, *Indiana Dept. of Conservation Publ. 21*, pp. 59–256. Indianapolis, 1922. 50 cents. 10 x 7 inches.

The state of Indiana comprises parts of two physiographic provinces within the great interior plains of the United States. The northern two-thirds of the state, lying within the Central Lowland Province, has been glaciated and is characterized by a belt of recent moraines and old lake beds crossing the northern quarter of the state from Lake Michigan eastward into Ohio, south of which stretches a wide belt of almost undissected till plains. This section offers no especially new or unsolved problems. In discussing it the author has drawn largely upon the writings of Dryer and Blatchley and Leverett's splendid monographs.

The northern moraine and lake region is subdivided into the following five belts: the Calumet lake section, being the old floor of Lake Michigan; the Valparaiso moraine, which rims and encloses the Lake Michigan basin; the Kankakee lake section of local till, sand, and outwash plains, lying just outside the Valparaiso moraine; followed by the Steuben interlobate moraine, formed jointly by the Saginaw and Erie lobes; finally to the east the Maumee lake section, representing the old floor of Lake Erie and bearing the same relation to the Steuben moraine as the Calumet lake section does to the Valparaiso moraine.

The middle belt of Indiana, forming the Tipton till plain, is a constructional feature in the zone of ice wastage and owes its little relief either to the low moraines whose knolls seldom rise over 40 and never over 100 feet above the plain, or to the old glacial waterways, now broad valleys leading southward across the plain.

The southern one-third or less of the state lies within the maturely dissected Interior Low Plateau Province. In this southern portion there has been no glaciation or the deposits are thin and insignificant. This southern area is the most rugged part of the state. Erosion upon a series of strata dipping gently westward from the axis of the Cincinnati arch has produced strips of upland and lowland which emerge from beneath the glacial cover at the north and extend southward across the Ohio River into Kentucky. Three uplands are described. The deeply dissected Crawford Upland, rising gradually eastward from the wide lowland of the Wabash River, which forms the western boundary in this part of Indiana, is the most rugged physiographic division of the state. Its steep eastern face overlooks the Mitchell Plain east of which there is a second gradual rise to the summit of the Norman Upland. This is terminated on the east by the well-known Knobstone escarpment, in places over 600 feet high, overlooking the Scottsburg Lowland, only to be succeeded by a third gradually rising slope to the summit of the less rugged Dearborn Upland which forms the eastern border of Indiana and extends into Ohio and Kentucky.

This part of the state is replete with problems of interest, mainly involving the dating of the peneplains represented on the several uplands, and a correlation with the Highland Rim and other levels outside of Indiana to the east and south. Obviously, from the inconclusiveness of this part of the paper, the physiographic history of the eastern United States, of which this problem is only one phase, needs some revision. It is not impossible that a radically new and more satisfactory interpretation may be offered by some careful investigator who studies the problem in its larger aspects.

In every respect Mr. Malott presents here a very valuable document, such as should be available for every state in the country. His tendency, however, to present his facts first empirically and later to explain them, unnecessarily burdens his reader with the need of carrying along many apparently unrelated physiographic matters while waiting for the explanation which is to link them together.

A. K. Lobeck

Physical Oceanography and Its Problems

R. L. Faris. **Some Problems of the Sea.** *Journ. Washington Acad. of Sci.*, Vol. 12, 1922 pp. 117–132.

J. T. Jenkins. **A Textbook of Oceanography.** x and 206 pp.; maps, diagrs., ills., bibliogr., index. Constable & Co. Ltd., London, 1921. 9 x 6 inches.

A. Berget. **Les problèmes de l'océan.** 329 pp.; maps, diagrs., ills. (Bibliothèque de Philosophie Scientifique.) Ernest Flammarion, Paris, 1920. 6 fr. 75. 7½ x 5 inches.

J. Thoulet. **L'Océanographie.** ix and 287 pp.; diagrs. (Collection "Science et Civilisation.") Gauthier-Villars & Cie., Paris, 1922. 7½ x 5½ inches.

J. Rouch. **Manuel d'océanographie physique.** 229 pp.; maps, diagrs., ills., index. Masson & Cie., Paris, 1922. 8½ x 5½ inches.

In "Some Problems of the Sea" Captain Faris directs attention to the larger problems of oceanography—not the problems of the specialist engaged in research in some restricted field of this vast domain, but those that are fundamental to oceanography and concern the various sciences that "meet in and upon the sea": the features of the ocean floor, sedimentation, oceanic circulation, tides and tidal currents, mean sea level, terrestrial magnetism, gravity, meteorology, and ocean temperatures.

"The mariner," Captain Faris points out, "sails on a more familiar sea than the oceanographer or the geophysicist." The meagerness of our knowledge of the floor of the open sea is well brought out by the fact that for the three oceans best known to man, outside the 1000-fathom line, "in the Atlantic . . . there is now one sounding for about each 12,000 square miles; in the Pacific, one sounding for each 25,000 square miles; and in the Indian Ocean, one sounding for each 26,000 square miles." Large areas of the ocean floor are still virgin fields for the oceanographer, there being "one region of two million square miles that has never felt a cast of the sounding line."

Our knowledge of the floor of the ocean is but typical of our knowledge of the open sea in general. Striking deficiencies exist in the matter of ocean temperatures; systematic tidal and current observations are wholly wanting, being confined to the immediate vicinity of the coast; a beginning—an excellent one, to be sure, but nevertheless a beginning—has been made in the magnetic survey of the oceans; a promising field has been opened up in the correlation between oceanographic and meteorological phenomena; much work remains to be done in the study of sea-level changes with reference to the elevation and subsidence of the coast—in fact throughout the realm of oceanography we have not yet arrived at the period of the "second decimal place."

The domain of oceanography is so large, and the expense involved in securing data is so considerable, that only in international co-operation lies the hope of results commensurate with the necessary cost. Captain Faris calls attention to this but finds encouragement in the growing recognition of the fact, as evidenced in the meetings of the Pan-Pacific Scientific Conference and in the establishment of the International Hydrographic Bureau.

Dr. Jenkins, in the preface to his "Textbook of Oceanography" calls attention to the fact that "in spite of the great interest that maritime questions have for the English-speaking nations, there is no modern textbook in English on the subject of oceanography." This need he has endeavored to fill in a work "designed to meet the requirements of the higher forms of schools, of teachers in training, and of students attending a school of geography at one of the Universities, as well as intending naval and mercantile marine officers."

The introductory chapter discusses the extent and the classification of the oceans, sea level, the hypsographical curve of the earth's surface, and the general features of the ocean floor. Chapter II deals with oceanic deposits and bottom fauna and with the permanence of the oceans. Chapter III treats of the temperature of the sea, the properties of sea water, sea ice, icebergs, atmospheric gases in sea water, and salinity. Chapter IV deals with waves and tides, and Chapter V is devoted to ocean currents.

To introduce the student to oceanography and acquaint him with the methods and results of modern oceanographic research in a book of 200 pages is no light task. One difficult problem is the extent to which the various topics are to be developed. Dr. Jenkins devotes a third of the book (Ch. V) to ocean currents—very nearly the same number of pages that are apportioned to all of the subjects discussed in Chapters I, II, and IV combined—yet under the section featured by the heading "Influence of the Coast" (p. 143) we find the following: "Marked deviations in the courses of ocean currents are produced by the obstructive influences of the coasts of the various continents and islands"—this and nothing more. In the section devoted to "The Influence of the Earth's Rotation" (p. 141) the effects on free currents and on wind-driven currents—two entirely distinct problems—are treated as if but a single problem were involved.

The chapter on tides, in particular, appears to have been done hurriedly. Under "Tidal Theories" four are named but only three described; a fifth—Whewell's progressive-wave, or Southern Ocean, theory—is introduced quite inadvertently and without being differentiated from the others. The tide predictor—the very name would appear to indicate its use in the prediction of tides—is described as a machine with which "the numerous calculations necessary in the harmonic analysis can be performed" (p. 118). Typographical errors in the formulae on pages 116 and 117 will prove confusing to the beginner. No mention is made of tide tables or the prediction of tides—surely interesting and important topics.

The bibliography is limited to publications in the English language. Under "Tides" (p. 201) only three entries appear; but G. H. Darwin's well-known book, "The Tides and Kindred Phenomena in the Solar System"—unquestionably the best non-mathematical introduction to the tides in English—is not listed. This is all the more surprising, since one of the illustrative figures (Fig. 19D) is credited to Darwin. And would it not be of advantage to call the student's attention to the standard work on oceanography—Krümmel's "Handbuch der Ozeanographie"—even though it be in a foreign language, especially when five illustrations are credited to its author?

There is great need for a textbook in English such as Dr. Jenkins had in mind, and it is to be hoped that a revised and considerably enlarged edition of his work will be forthcoming in the near future. Opportunity will then be afforded for giving the correct spelling of "areometer" (not "aerometer," as on pp. 71, 72, and 203); for giving the correct length of the tidal day, 24 hours 50 minutes (not 24 hours 40 minutes, as on p. 109); and for including among "The Principal Ocean Deeps" (p. 22) the "Planet" sounding in the Swire Deep, which is the greatest depth so far recorded and which exceeds by 500 feet the depth given by Dr. Jenkins as the greatest.

In "Les problèmes de l'océan" Professor Berget sets out to develop in non-technical language the problems of oceanography. The first five chapters deal with the chemical and physical properties of the ocean waters, the sixth chapter with sea ice, and the three following chapters with waves, tides, and currents. Successive chapters take up the distribution of land and sea, the depths of the ocean, changes in shore line, the floor of the ocean, and a consideration of the past and the future of the ocean.

Though writing in a somewhat popular style, Professor Berget manages to cover the ground in a thorough manner. Not only in the choice of topics but also in the extent to which they are developed is a nice sense of proportion exhibited. This is especially well shown in the chapter on tides—a difficult subject and one which suffers in most oceanographies. In the 38 pages devoted to the tides, Professor Berget gives an unusually satisfactory discussion of the subject. "Les problèmes de l'océan" is in no sense a manual or a textbook, being intended not for the student but for the intelligent layman whose reading of it should give him an insight into the problems confronting oceanography and the progress made in their solution.

"L'Océanographie," by J. Thoulet, is the work of a veteran French oceanographer whose contributions to the subject extend over a considerable number of years and whose publications, especially "Océanographie (statique)" (Paris, 1890) and "L'Océan: Ses lois et ses problèmes" (Paris, 1904) are well known. For Professor Thoulet physical oceanography divides itself into two distinct parts: "océanographie statique" which deals with the physical and chemical characteristics of the ocean waters and with the topography and deposits of the ocean bottom, and "océanographie dynamique" which deals with the movements of the sea—waves, tides, and currents. After an introductory chapter discussing the province of oceanography and its relation to the various specialized sciences which it employs, five chapters of "océanographie statique" follow, dealing respectively with the extent and depths of the ocean, the bottom of the sea and its deposits, the chemistry of sea water, the physics of sea water, and sea ice. The last three chapters of the volume are devoted to "océanographie dynamique" and deal respectively with waves, tides, and currents.

Thoulet's researches have been largely in the field of "océanographie statique"—a field in which he speaks as a specialist of recognized authority—and no doubt this accounts for the fact that the greater and more interesting portion of "L'Océanographie"—very nearly three fourths of the volume—deals with that part of the subject. "L'Océanographie" is not a manual nor a treatise, its character being very largely determined by the aims of the collection, "Science et Civilisation," in which it appears and whose purpose, the editor informs us, is to make known "au public cultivé les résultats obtenus dans tous les domaines où s'exerce l'activité de l'esprit humain." Because of its interesting presentation of the subject matter of oceanography and despite its meagerness of treatment of tides and tidal phenomena and despite, too, the meagerness of illustrations—eight figures in all—"L'Océanographie" is a welcome volume.

Commandant Rouch, in the introduction to his "Manuel d'océanographie physique," explains that his aim was to produce a practical manual—"such as I myself should like to have had when I left for my first oceanographic work"—and in the reviewer's opinion the author has been eminently successful in his undertaking. The book is divided into two parts. The first part deals with the methods and instruments of observation relating to soundings, temperatures, densities, waves, tides, currents, and sea ice. The second part, constituting the greater portion of the book, discusses the principal results of oceanographic work, a chapter being devoted to each of the following subjects: distribution and general classification of seas, the depths of the ocean, the bottom of the ocean, salinity of sea water, temperature of the ocean waters, color and transparency of the sea, swells and waves, general notions of the tide, causes of the tide, ocean currents, and sea ice. Three appendices follow: the first deals with tow nets, the second lists the oceanographic instruments to be taken along on an oceanographic cruise, and the third gives a number of conversion tables.

By omitting a discussion of the more specialized problems of the various branches of oceanography, the author has succeeded in producing an excellent introductory manual within small compass. Indeed, so well balanced is the presentation of the subject matter that the single chapter in which the treatment is more mathematical and more specialized than is called for in an elementary text—the chapter on the causes of the tide—stands out strikingly. Two quotations may perhaps bring out the author's viewpoint. In speaking of the classification of the seas he says in a footnote "Il faut se garder de donner raison aux détracteurs de la géographie, qui prétendent qu'elle n'est qu'une science de mots et que les géographes sont les derniers 'nominalistes' " (p. 63). In the section dealing with the depths of the sea, after stating that the mean depth of the ocean lies between 3500 and 4000 meters, he appends the following footnote (p. 64): "Krümmel, dans son 'Handbuch der Ozeanographie,' ose écrire 3997 mètres. Qui espère-t-on impressionner avec une pareille précision?"

H. A. Marmer

Tropical Cyclones

E. V. Newnham. **Hurricanes and Tropical Revolving Storms.** With an Introduction on the Birth and Death of Cyclones by Sir Napier Shaw. viii and pp. 213–333; maps, diagrs., bibliogr. *M[eteorol]. O[ffice Publ. No]. 220i, Geophysical Memoirs No. 19,* London, 1922. 12s. 6d. 12 x 10 inches.

Sir Napier Shaw's 14-page "introductory note" deals in a profound manner with the difficult subject of the life history of cyclones. It states the convectional theory of cyclones so as to conform with recent evidence as to barometric conditions in the upper air in cyclones, as well as with Bjerknes' hypothesis of the Polar Front and with Lord Rayleigh's work on revolving fluids in the atmosphere. However, no explanation is offered for the wide variations from year to year in the number of cyclones or for their distribution over the tropics. It is stated that two of the desiderata are a fuller knowledge of local differences in the intensity of convection in the tropics and of localization of precipitation within cyclonic disturbances. Dr. Shaw appears to feel that if these two factors were known the origin and movements of tropical cyclones could perhaps be predicted. One statement is made so radically opposed to that made by Humphreys that it should be quoted. Dr. Shaw says, "nearly all of the tropical cyclones turn out of the easterly drift and recurve into the prevailing westerlies." Since usually more than forty tropical cyclones develop annually in the northern hemisphere, this statement implies an important movement of cyclones from the tropics to mid-latitudes. Humphreys, on the other hand, states ("Physics of the Air," p. 196) that probably only two or three tropical cyclones migrate annually northward out of the tropics.

Mrs. Newnham's 106 pages are a helpful compilation of some of the published data concerning tropical cyclones, especially their frequency in certain regions. It is unfortunate, however, that the compilation has not been more thoroughly done. For instance, very little use was made of the valuable works in German concerning the Pacific and Indian oceans or of the publications of Froc ("Atlas of 620 Typhoons," 1920), and Coronas ("Climate and Weather of the Philippines," 1920) concerning typhoons. No mention is made of tropical cyclones off the west coast of Mexico. Many statements made in the general introduction are contradicted by data, charts, or detailed descriptions given in subsequent pages.

A rather full summary of Fassig's "Hurricanes of the West Indies" (*U. S. Weather Bur. Bull. X*, Washington, D. C., 1913) is given together with mention of storms which occurred in the years 1912–1919. These latter storms are likewise included on the charts of storm tracks by months. Half of the twenty pages are filled with accounts of recent storms, reprinted from the *Monthly Weather Review.* For the years 1876–1919, 159 severe hurricanes are tabulated. Eighty-six per cent occurred during August, September, and October. On the average, four storms occur a year; but in four of the years none occurred, while in five years eight or more have occurred annually.

The next section (11 pages) is on "Storm Squalls and Tornadoes of West Africa," most of the data coming from Henry Hubert. The western Sahara and neighboring regions experience storms rather frequently. They are not, however, of the same type as most of the storms discussed in this memoir, being mostly local and of brief duration. This is remarked in the general introduction but is not made very obvious in the discussion itself. This section might better have been placed in an appendix, together with a discussion of similar storms of Australia and several other regions. Indeed, information concerning local storms of these severe types is badly in need of compilation.

As might be expected in a British publication, the section on the Indian Ocean is particularly full, forming one-third of the memoir. Fifteen pages are devoted to the cyclones in the Bay of Bengal, ten pages to those of the Arabian Sea, and twelve pages to those of the South Indian Ocean. The discussion of the Bengal cyclones is a summary of Sir John Eliot's comprehensive "Handbook of Cyclonic Storms in the Bay of Bengal" (1900) supplemented by data collected from the Indian *Monthly Weather Review* for the years 1900–1912. The tracks of many of the storms of 1900 to 1912 are shown on charts. As to frequency, on the average ten cyclones occur annually in the Bay of Bengal; of which about two are severe, four are moderately severe, and four are feeble. As to monthly occurrence, July, August, and September each have from 15 per cent to 19 per cent of the storms, while June has 12 per cent, October 14 per cent, and November 10 per cent.

In the Arabian Sea, cyclones are less frequent—about two a year. The data given in the present memoir concerns only 1890–1912, no summary being given of Dallas' memoir discussing the recorded storms occurring before 1889. In monthly occurrence, the cyclones of the Arabian Sea are notable in showing two well-marked maxima, in June and October. Cyclones are very rare or lacking during February and March, when the winter monsoon is blowing steadily, and in August, when the summer monsoon is at its height.

The cyclones of the South Indian Ocean were long studied by Meldrum; and the study was continued until recently by Claxton, lately director of the Royal Alfred Observatory at Mauritius. They are comparatively frequent, nearly ten occurring annually near Mauritius, and others in the general region. Some correspondence between the frequency of the cyclones in the South Indian Ocean and solar spottedness is conceded, although it is stated that the specially severe type of storm appears to be as frequent in years of minimum solar activity as in years of maximum.

The tropical cyclones of the Pacific are considered in 24 pages, half of which are devoted to the typhoons and half to the hurricanes of the South Pacific and Australia. The discussion of typhoons is almost entirely on the basis of Algué's "Cyclones of the Far East" (1904); that of the hurricanes affecting Australia solely from Taylor's "Australian Meteorology"; while most of the data concerning the South Pacific applies only to Fiji and is from a fragmentary report issued by the Colonial Superintendent of Agriculture. Data concerning the tropical cyclones of the Pacific have recently been gathered in the field and from numerous publications by the reviewer. The discussions published in the *Monthly Weather Review* since this memoir was prepared make available many more data.

Stephen S. Visher

The English Village Community

Harold Peake. **The English Village: The Origin and Decay of Its Community: An Anthropological Interpretation.** 251 pp.; maps, diagrs., ills., bibliogr., index. Benn Bros., Ltd., London, 1922. 15s. 9 x 5½ inches.

The scope of this volume extends far beyond the limits of geography. Its interest for the geographer lies rather in what it suggests than in what it presents. Its suggestions, however, are manifold. Peake has sought to trace the origin, development, and decay of the community social groups of England and has endeavored to evolve a plan for the reconstruction of the village on lines that will provide a coherent life, satisfying and self-contained, on which future progress might be based.

Criticism of the book is a matter for the anthropologist, historian, and economist. Geography may draw from it certain suggestions for the study of the development of population groups, wherein leads for a method of study are discernible. The village community is traced to its earliest sources, and its prototype is seen by Peake in the Alpine lake dwellings of Switzerland. In developing this origin he takes up a thread which appears again and again in the work in pointing out that the stabilized community system was built upon an aristocracy of steppe folk, who "lorded it" over a serfdom of agriculturists. Hence he deduces the beginnings of the exclusive aristocracy of pre-revolutionary France. From the lake dwellings sprang the nucleated village, while the dispersed village, later giving rise to the forest village in England, appears to have originated in the forested plains of Germany. The appearance of each social form in England is traced as far as knowledge permits, and the modification of the form is followed in detail, being ascribed mainly to racial influence. The numerous anthropological types to be found in the village itself and in the region are tracked to the distant lands of their origin, and an interpretation of character on the basis of appreciation is attempted in the spirit of the recent series of works on the "Making of the Future," to which Peake was a contributor.

The main geographical implication of the book is the intimate connection between the village and its area, the small territorial subdivision known as the township. The whole history of the development of village and township in England is the history of the reaction of a small social group confined to a small area which was often a geographical unit, or natural district. It is the history of the growth of the group in its district and of the exploitation of the district by the group. It throws a considerable light on the course of population growth under relatively stable conditions of occupation and from this angle has been analyzed at some length in the preceding number of the *Geographical Review* (see pp. 275–278) and will therefore not be further considered here.

M. AUROUSSEAU

A COMPREHENSIVE TREATISE ON THE POPULATION PROBLEM

A. M. CARR-SAUNDERS. **The Population Problem: A Study in Human Evolution.** 516 pp.; bibliogr., index. The Clarendon Press, Oxford, 1922. $7.00. 9 x 6 inches.

This exhaustive and scholarly treatise is an examination of the phenomenon of human propagation and is essentially a biological and sociological work. It deals with man as the special biological case of a species capable of exerting a conscious influence upon its own development and a conscious modification of its own environment. The whole range of human history has been diligently searched for material, and illustrations are culled from every part of the globe.

The author seems to regard the Malthusian statement of the theory of population as inadequate rather than incorrect and has himself arrived at the principle of the "optimum density of population" as an explanation of the nature of human increase. He holds that the principle of the optimum is valid for primitive as well as civilized races and that numbers are adjusted to the optimum for a given region by acceleration of increase in response to economic conditions, if below it, and by more or less conscious check, even among primitive races, if the optimum has been exceeded. The nature and variety of checks upon population growth among savage and primitive peoples are examined in great detail and supported by abundant evidence. The treatment is not statistical but remains empirical throughout and is very convincing. Carr-Saunders' primary effort, unlike that of Pearl and others, is not to state a law of population growth but rather to discover the true nature of the principle of human increase. It cannot be maintained that he has discovered it, but he has undoubtedly indicated a tendency towards conscious adjustment. The quality of human product is considered in detail, a large part of the volume being devoted to a study of the evolution of physical and mental characters and the effects of heredity and tradition. The conclusion is reached that physical improvement of humanity through gradual germinal change is possible but that the effects of germinal change upon mental characters are negligible in the long run, being greatly outweighed by the overwhelming effects of tradition.

There is little in the volume that can be given direct geographical application; but it is a work, nevertheless, which is likely to prove indispensable in demographic geography, as it provides a sound philosophic background and a mass of information of the greatest utility. The liberally summarized table of contents, the classified lists of references, and the index make it an easy and attractive work to consult.

M. AUROUSSEAU

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THE
GEOGRAPHICAL REVIEW

VOL. XIII OCTOBER, 1923 NO. 4

GREATER STOCKHOLM

A GEOGRAPHICAL INTERPRETATION

By STEN DE GEER
University of Stockholm

Most geographers now agree that cities should be studied systematically as important, complicated, and interesting geographical regions albeit small in areal extent. Such treatment is especially called for in the case of the large cities, where the urban regional type is most distinctive and where the most complete subdivision of function is exhibited, that is where subregions can be identified.

An European and an American type can be distinguished in most modern cities. The American type has a concentrated "city" area and a very wide residence zone depending on an earlier development of rapid communications between city and outer zone. The European type is characterized by a large city district and a dense residence region.

Stockholm, the capital of Sweden, is an interesting transition type. For long typically European, it has recently developed an extensive outer residence zone somewhat American in type. There are several other geographical features in the development of Stockholm to its present metropolitan character which easily escape the native resident as well as the interested visitor. Details such as streets, stores, and official buildings are known or remarked, but they are seldom considered in relation to *position*. That geographical laws determine the best position and distribution of each particular phenomenon is rarely a matter of conscious appreciation. Yet it is such laws that determine the areal growth and outer shape of the city as well as the distribution of function between its different parts and so differentiation in interior structure.

The influence of geographical situation is readily perceived. Beginning with the ninth century for 150 years (800–950) Birka, 18 miles west of Stockholm, and subsequently for 250 years (950–1200) Sigtuna, 47 miles northwest of Stockholm, were the principal places of the Mälaren plain and all Svea-

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land. Then Stockholm arose at the outlet of Lake Mälaren into the Baltic. Since the middle of the thirteenth century it has been the chief center, and it will long continue to be because of its favorable situation at the crossing between water routes and land routes.

The Early City

East and west runs a north-facing fault escarpment (Södrabergensbrant, Fig. 1), succeeded to the east by a bay of the Baltic (Saltsjön) and to the west by a bay of the large Lake Mälaren, the main waterway of central Sweden. Where a north to south running gravel esker crosses the depression in front of the fault escarpment, a lock (Slussen) has been built joining Lake Mälaren to the Baltic. North of the lock is a rounded flat esker hill (Stadsholmen), where the old city grew up. It was bounded to the north by the River Norrström, the short natural outlet of Lake Mälaren, which was overlooked from the northeastern corner of the city by the old Stockholm castle, the key to Mälaren. On the site of the medieval castle the present royal palace was built 200 years ago.

In the plan of Stadsholmen and Riddarholmen can still be traced centers with triangular blocks (Fig. 2, VS, VR). In Stadsholmen the slopes of the oval esker are occupied by two to three parallel longitudinal streets with long and narrow intervening blocks. Along the foot of the hill ran the city wall, now no longer in existence, and outside this Västerlånggatan and Österlånggatan, which limit this second city region. A third belt has transverse, narrow blocks and numerous radiating alleys leading down to the ancient shores of the isle—to Lake Mälaren in the west, to the Baltic in the east (Fig. 2, G). These three belts were developed during the sixteenth century and correspond to the "old city" of the continental cities. After the fire of 1625 the district outside the city wall to the west was rebuilt on a rectangular plan with almost square blocks, so as to become a typical "new city" (Fig. 2, R).

As a consequence of the limited space within the fortified "Staden mellan broarna" (City between the bridges) the streets were very narrow and the gabled houses many storied. Suburbs with small wooden houses and without regulated streets extended over wide areas on the mainland north and south.

City Planning and Rapid Growth

Stockholm has known two periods of extensive city planning. The first "modernization" dates from 1635 when for the following decade the energetic governor General Klas Fleming carried through a great program of street widening and leveling. The second effort, resulting in the present city plan, was begun in 1866 under Albert Lindhagen. While Fleming, among other things, aimed at a street width of at least 16 feet, Lindhagen planned a width of 36 to 54 feet in the central section and 72 to 90 feet in the outer parts of the city. Both improvements coincided with periods of prosperity and rapid development. The first was consequent on the centralization of the Swedish administration under king Gustavus Adolphus and with the rise of Sweden to a great power through its dominion of the Baltic with Stockholm as commercial center. The second period of rapid development followed on the industrialization of Sweden and the localization in the capital of a variety of industries, especially such as call for final elaboration of the product.

In 1800 Stockholm housed 2½ per cent of the inhabitants of the country and still the same proportion in 1850, but during the next half century the figure rose to 7½ per cent. Population and housing accommodations during this later period have become several times greater. The height of the houses has been increased, the yard spaces have decreased, and the city has continuously expanded outwards. Characteristically this outward spread is no longer concentric to the city nucleus, as in earlier days, but is far more extensive along the lines of communication.[1] The outer limit of the city therefore assumes a more and more intricate contour, with many offshoots, and includes a number of secondary centers of growth. The sparsely occupied outer part of the residence region with its new suburbs and villa cities now forms eleven sector-shaped districts, which become wider but less populated the farther one goes from the center of the city (Fig. 1). A certain symmetrical uniformity has arisen as a consequence of the straight west-east fault escarpment of the Södra heights and the depression from Lake Mälaren to the Baltic (Fig. 1).

The Suburban Zone

The steamboats on Lake Mälaren (to Essingen) serve a rather narrow sector with 7500 inhabitants.[2] Those on the Baltic (to Augustendal) serve a still narrower sector with 2000 inhabitants living for the most part on the southern rocky shore, where a prosperous industry has developed.

Southward from the fault escarpment open three wide traffic sectors. Towards the southwest, trolley lines run to Tellusborg and Fridhem, serving a sector with 14,000 inhabitants. Towards the south, another line leads to Enskede, continued by stage to Örby-Älvsjö. These places with their environs also can be included with the southwestern sector, as they share with it suburban railroad service to the inner city. With the two places mentioned the southern sector counts 12,000 inhabitants, without them 6000. The southeastern sector, Nacka parish, which is served by railroad, has 8000 inhabitants and comprises the most hilly, rocky, and forested part of the closer surroundings of Stockholm.

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[1] Cf. the map of Paris, Fig. 17 in L. Gallois' article on Paris in the July number of the *Geographical Review*.

[2] The number of inhabitants in the outer belts of the traffic sectors has been calculated from A. Söderlund's dot map of 1919 as being, within the inner suburban region, more detailed than the writer's map of 1917 (see a reproduction in Fig. 2 of "A Map of the Distribution of Population in Sweden: Method of Preparation and General Results," *Geogr. Rev.*, Vol. 12, 1922, pp. 72–83).

The peninsulas of Södra Djurgården and Kungsholmen were separated by canal from the northern mainland in 1834 and 1866 respectively and now, together with parts of the mainland, form traffic sectors served by trolley lines as well as by steamboats. The districts comprise only 2000 and 4000 inhabitants respectively. The remaining area on the northern mainland is divided into three wide sectors which all have bays or sounds as natural traffic divides. The northeastern sector, between the Lilla Värtan and Stora Värtan, is the most extensive and counts 12,000 inhabitants; the northern sector, between Stora Värtan and Lake Brunnsviken, has 9000 inhabitants; and the northwestern sector 34,000 inhabitants. All have good suburban railroad service, mainly electrical.

The total population of the outer districts is 105,000, considerably less than that of the inner residence region, which counts 370,000 inhabitants (1917). The relative difference between them, however, is decreasing. The annual increase of population in Greater Stockholm is nearly 2 per cent. In the outer belt, however, the rate is far more rapid; for in the business region there is virtually a decrease. The limit between the outer and the inner part of the residence region is extraordinarily sharp. While, as a rule, the density of population of a metropolis is greatest in the innermost belt of the residence zone and from there, together with the height and density of the houses, gradually decreases outwards, the density in Stockholm, on the contrary, increases outwards towards the boundary of the compact region, where five-story apartment houses occupy solid blocks. The transition to the surrounding, uninhabited districts is often quite abrupt—houses on one side, forested granite hills and cultivated clay valleys on the other. Farther out, however, lie garden suburbs which normally grow thinner and smaller the farther outward.

This remarkable discontinuity in the concentric density belts of Stockholm reminds one of Königsberg, the capital of East Prussia, where similar discontinuity has been caused by a too long maintained zone of fortifications, the city becoming too dense within this ring, while building outside it was long rendered difficult or prohibited.

Since the time of Klas Fleming the growth of Stockholm, to be sure, has been checked not by fortifications but by an almost encompassing ring of other obstacles, chiefly of an artificial nature—parks and the military training ground—in the northern section, chiefly natural difficulties in the southern section—water areas backed by stretches of forested rocky hills, mainly belonging to parallel fault escarpments.

Because of this sharp limit between urban and rural zones, building lots have been expensive, rents high, the development of the sparsely occupied outer zone of the residence district retarded, and the incorporation of this zone late. The minor city of Königsberg incorporated its outer section in 1905; Stockholm began in 1912 with the southern and southwestern sectors and continued in 1915 with the western sector (Brommalandet). The sectors in the north and northeast, outside Östermalm, the wealthy northeastern part of the interior residence region, contain more well-to-do communities which try to escape incorporation by organizing themselves as separate cities or boroughs.

The Inner Residence Zone

Within the inner residence region separate sectors cannot be traced on account of the uniformly dense manner of building; but traffic streams and trolley lines converge as distinctly as in the outer region towards the center—towards the city in the geographical sense. The numerous trolley lines converge on three principal points; Tegelbacken in the west, Norrmalmstorg in the east, and Slussen in the south indicating the position of the three principal parts of the city district. Between the three points lies Gustav Adolfstorg, the organic center of Stockholm. To each of the three chief points corresponds a secondary meeting point lying farther out towards the limit of the city district. At the beginning of the present epoch of development old Stockholm, the city between the bridges, was the center of business and administration. The fact that all steamboat lines then as now radiated from the old city meant more then than it does today. The great development of

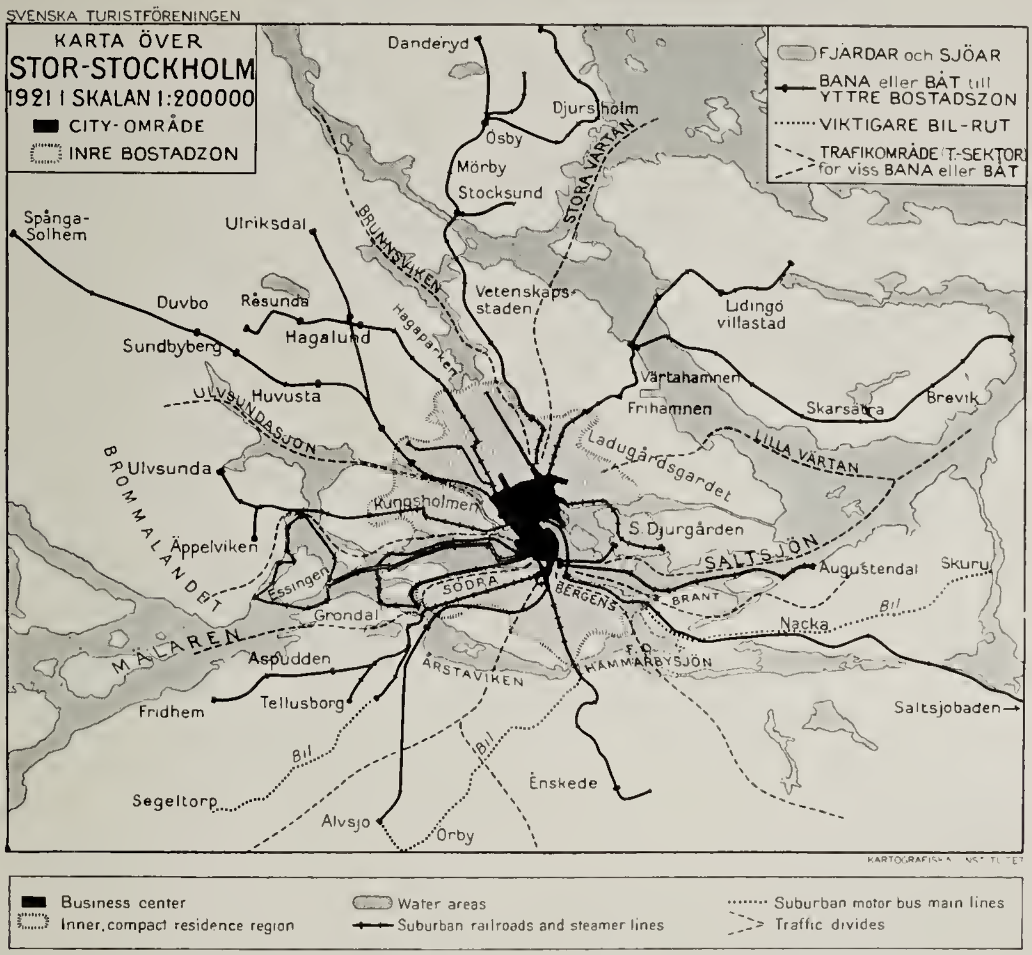


FIG. 1—Map of Greater Stockholm, 1921. Scale 1:200,000. This and the succeeding figures are printed from the original blocks accompanying Dr. De Geer's article "Storstaden Stockholm ur geografisk synpunkt" (Svenska Turistföreningens Årsskrift, 1922), courteously loaned by the Swedish Touring Club.

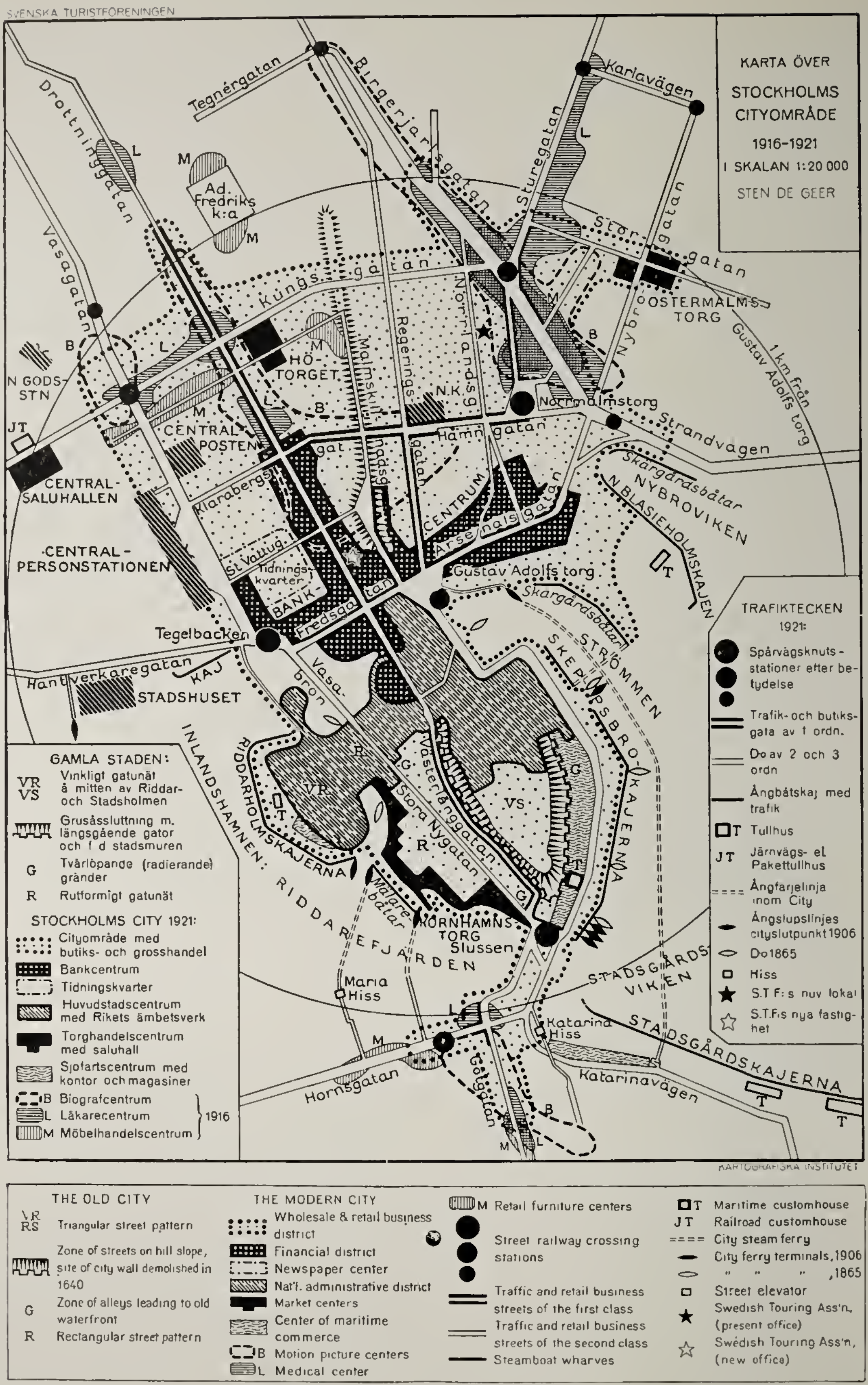
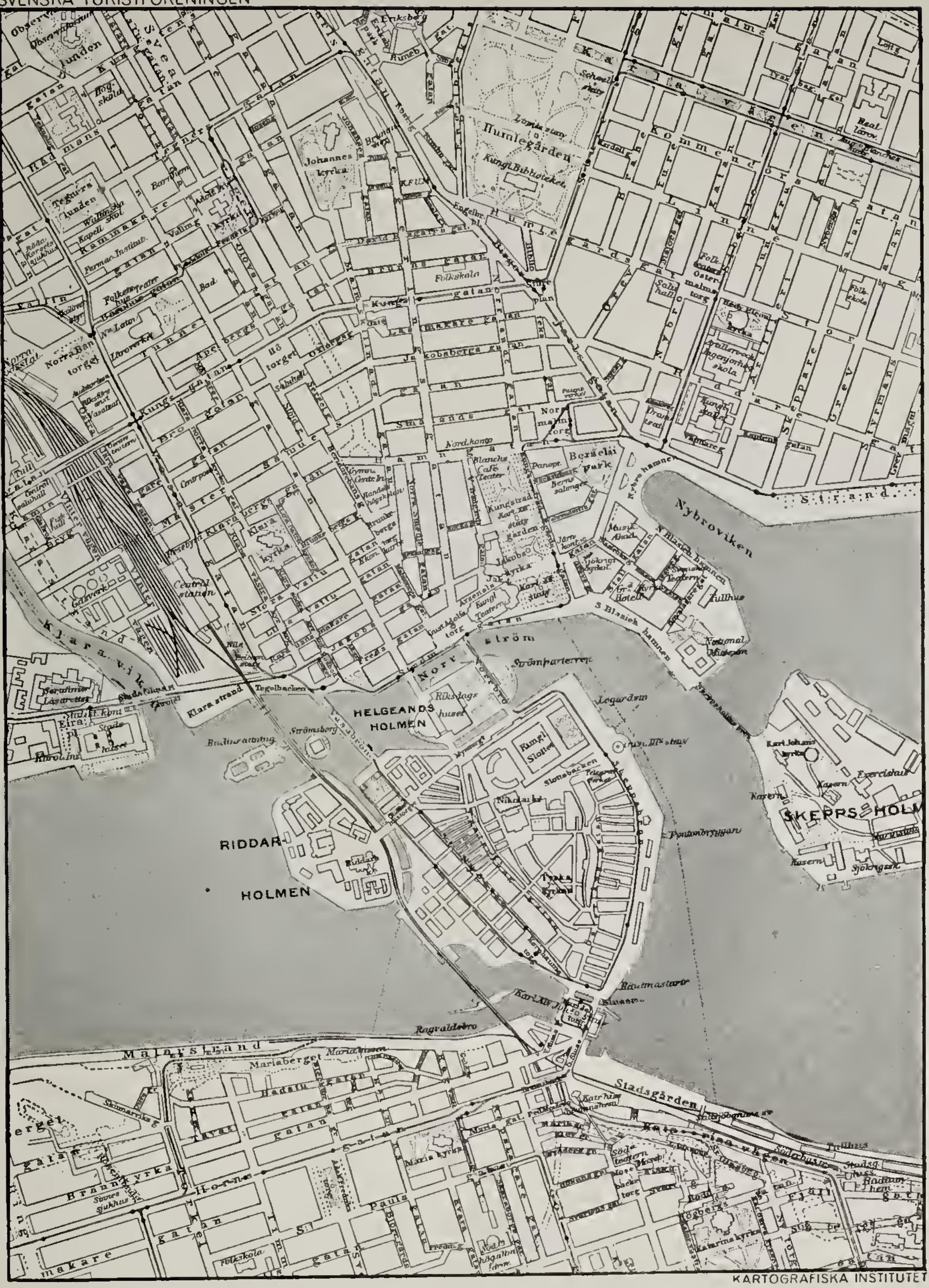


FIG. 2—Map of the business center of Stockholm. The map covers 1¼ x 1¾ statute miles.

the net of trolley lines in Norrmalm has favored the removal of business to lower Norrmalm, which has become the modern city of Stockholm. There also end the new suburban railroad lines from the outer parts of the residence region. Street traffic, as a whole, radiates from the center of the city district:

SVENSKA TURISTFÖRENINGEN



KARTOGRAFISKA INSTITUTET

FIG. 3—Map of the central part of Stockholm. Compare with Figure 2, which is on a slightly larger scale.

and radiating streets are therefore the chief business streets. The map (Fig. 2) shows traffic and retail streets of the first, second, and third order according to the writer's estimation. Classification has been based on both the amount of pedestrian traffic and the percentage of street front given to window space for retail business, which affords a sensitive indication of the quality of the position.

The space between four traffic streets can be called a traffic block as distinguished from the individual city squares which alone stand out on ordinary maps. The traffic block is crossed by quiet non-traffic streets and is occupied by retail trade only along the edges. In the middle are wholesale trade, small industries, and all kinds of businesses and organizations which require a central position but not direct contact with the public at large on the traffic streets.

The Central Business District

The limit of the entire central business district (Fig. 2) can be determined either by the development of the shops on the traffic streets or statistically as, for instance, by the percentage of rooms used for other purpose than residence. The city district of Stockholm covers about double the average proportion, partly because of the removal of the center to lower Norrmalm, while the old city still forms part of the district, and partly because of the not very intensive utilization of the central portion about the esker in Norrmalm. The modern business center forms a U-shaped zone around this esker (within Vasagatan, Fredsgatan, Arsenalsgatan, and Birgerjarlsgatan). The western part of the old city and Södermalm south of Slussen also have the lively traffic of a large city, although mostly as a thoroughfare to and from Södermalm. Slussen has the most intense circulation in the city because Stockholm, like many large American and eastern European river cities, is here a one-bridge city, geographically speaking.

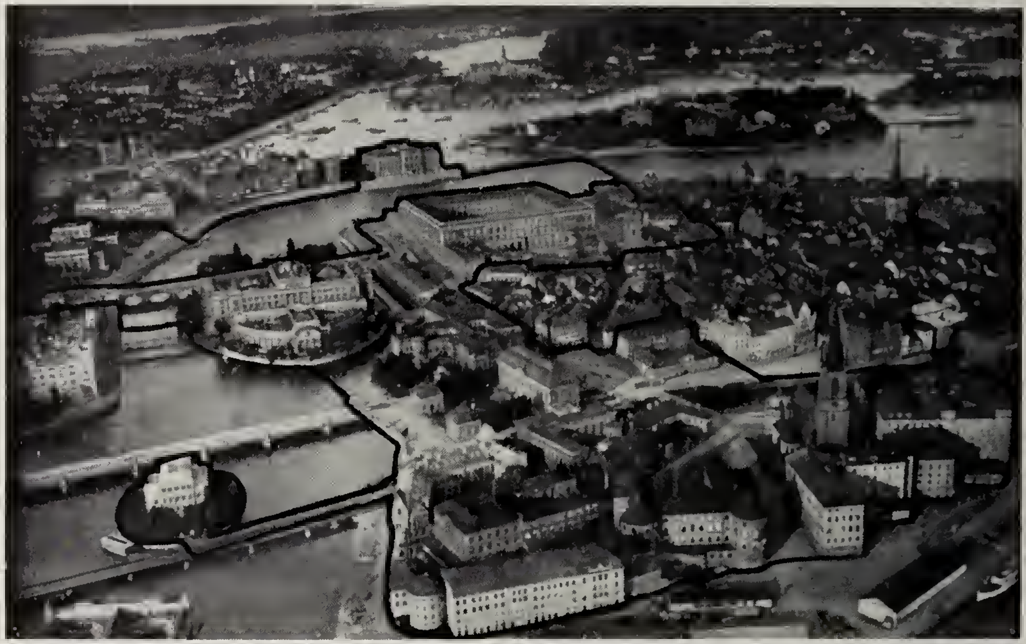


Fig. 4—Stockholm, showing the quarter of the city occupied by government and other public buildings.

As we have already seen, three districts can be distinguished in the city: a western and an eastern part on each side of the esker ridge (Malmskillnadsgatan) and a southern part (reaching from the old city up to the crossing of Hornsgatan and Götgatan). This will be particularly evident from a closer examination of the geographical position of different branches of business.

The map shows that the motion picture theaters are largest and most numerous at the crossing of Kungsgatan and Vasagatan and on Drottninggatan and Hamngatan in the west; along Birgerjarlsgatan in the east; and along Götgatan in the south.[3] The physicians, who fifty years ago were either concentrated in Fredsgatan or scattered over the city, now principally live about Birgerjarlsgatan and Sturegatan since, thanks to the automobile, they have become more independent of the distribution of the population. A number of physicians also live about Kungsgatan, Drottninggatan, Hornsgatan, and Götgatan. The same three groups of positions are seen again, for instance, in the localization of the furniture business, which also has been made the subject of a special study. Whereas furniture shops cannot occupy positions on the traffic streets, because of the bulky character of the business, but are situated somewhat on the side streets, the offices and apartments of the physicians face the main streets even in the expensive eastern part.

The provision business is largely distributed among three centers: Hötorget in the west, Östermalmstorg in the east, and Kornhamnstorg in the south. Each one consists of market, sale hall, and a surrounding zone of retail shops of different kinds. The new municipal "Central" market lacks the dependent shops and is in fact not more central than were the older markets, as it lies two-thirds of a mile from the center of the city to the west. But the provision business does not need the best central position, being properly located in the transition zone between the business center and the residence region.

Many branches of business do not show the like localization in three centers but are strictly limited to a particular part of the large city district. This is the case with the centers of long-distance traffic. The center of maritime commerce lies on the east side of Stadsholmen, with a recent extension on the southern mainland. Of the three natural harbor basins the position of the central one, for Lake Mälaren as well as for the Baltic, is shown on the map by the line of customhouses and quays (Fig. 2). Long-distance traffic by land is drawn to the Central Passenger Station, Northern Freight Station, Railroad Customs Station, and the Central Post Office, all of which lie on Vasagatan on the western edge of the city district. Here also the hotel and newspaper centers are situated. The Central Station of the national railroads, however, lies not half a mile from Gustav Adolfstorg. In this respect Stockholm is comparable with the large cities of the Anglo-Saxon countries, where competition between railroad companies has greatly reduced the distance between the stations and business centers.

The Banking Center

Gustav Adolfstorg is the center of Stockholm, where the banking center and civil service department meet. The government offices and the historical buildings, comprising the center of the political administration, are situated in the northern part of the central islands and in the adjacent part of Norrmalm. The central offices of the banks and the other large offices, forming the center of financial administration, take the most central position on and about Freds-Arsenalsgatan, where they have almost crowded out the stores. The stock exchange is still situated in the old city, though its removal to near Fredsgatan has been under consideration. On Drottninggatan, which has the greatest pedestrian traffic, the stores have had the best of it, the banks situated there having only a narrow front on this street.

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[3] The map is based on a compendium after a detailed, graded dot map of 1916.

Two different grades of areal intensity can be distinguished within the region of the commercial city: a higher for the bank center, and a lower for the rest of the city district. The difference between the residence region within and outside the former tollgates, however, is still greater. Considered from such a point of view Stockholm may be divided into four concentric zones: the banking center, the remaining city district, the densely built residence zone, and the sparsely built suburban belt, all of which present their own geographical characters.

PHYSIOGRAPHIC REGIONS OF THE NETHERLANDS

By P. Tesch
Geological Survey of the Netherlands

The prime physiographic interest of the Netherlands lies in its situation on "the shifting edge of Europe." The surface of the country covers some 12,700 square miles (33,000 square kilometers), exclusive of the "tidal lands," *wadden*, extending along the northern shores which are still subject to invasion by the sea at each flood. Nearly three-fifths of this area is constituted by land formed only during the human period and made habitable only through man's interference. This is the "lowlands" of a country that lies almost entirely below the 100-meter contour line.

The Lowlands

The lowlands is a flat alluvial plain separated from the sea by chains of sand dunes locally attaining heights of 60 meters above sea level and broken by wide estuaries and tidal channels. It evidently represents an ancient lagoon closed by a sand barrier and filled by river sediments in co-operation with tidal action. Layers of peat alternating with the silt layers indicate littoral conditions of formation during a time of relative depression of the land (fully 20 meters since the termination of the Pleistocene). The greater part of the surface is below the level of the sea, in places as much as five to six meters below, and drainage is entirely artificial. Drained and intensively cultivated, these former swamps and lakes are the well-known Dutch "polderland."

The earlier inhabitants, in the days of Caesar's invasion, built low hills, *terpen* or *wierden*, on the marshes exposed to inundation. The hills, which were first raised above the level of high tide, gradually grew in height by the accumulation of the débris of settlement and came to offer comparatively safe refuges for men and cattle in days of storm flood. About 1000 A. D. the first dikes were built, since when they have been constantly improved. The artificial hills were no longer needed by the inhabitants, though most of the older settlements (now small towns and villages) in the lowlands of Friesland and Groningen still occupy each a separate *terp*. On the other hand, many *terpen* are now being dug up for use of the black fertile earth as fertilizer; and these have yielded many valuable documents (implements, pottery, etc.) on the early history of the Netherlands and its inhabitants.

Drainage of the Lowlands

The first dikes were of a very primitive type and had for their sole purpose exclusion of the inundation waters of rivers and sea. In the fourteenth century the familiar windmill was first used for removing the superfluous inner waters, and the highly distinctive character of the Dutch polderland dates from this time. The mills lift the water via several sorts of ditches and channels to a level from which it can be discharged into the rivers or the sea. For this purpose the whole region of the lowlands is covered by a complex system of drainage, consisting of ditches, dikes, mills, and sluices. In this way it has become possible to control completely the inner water

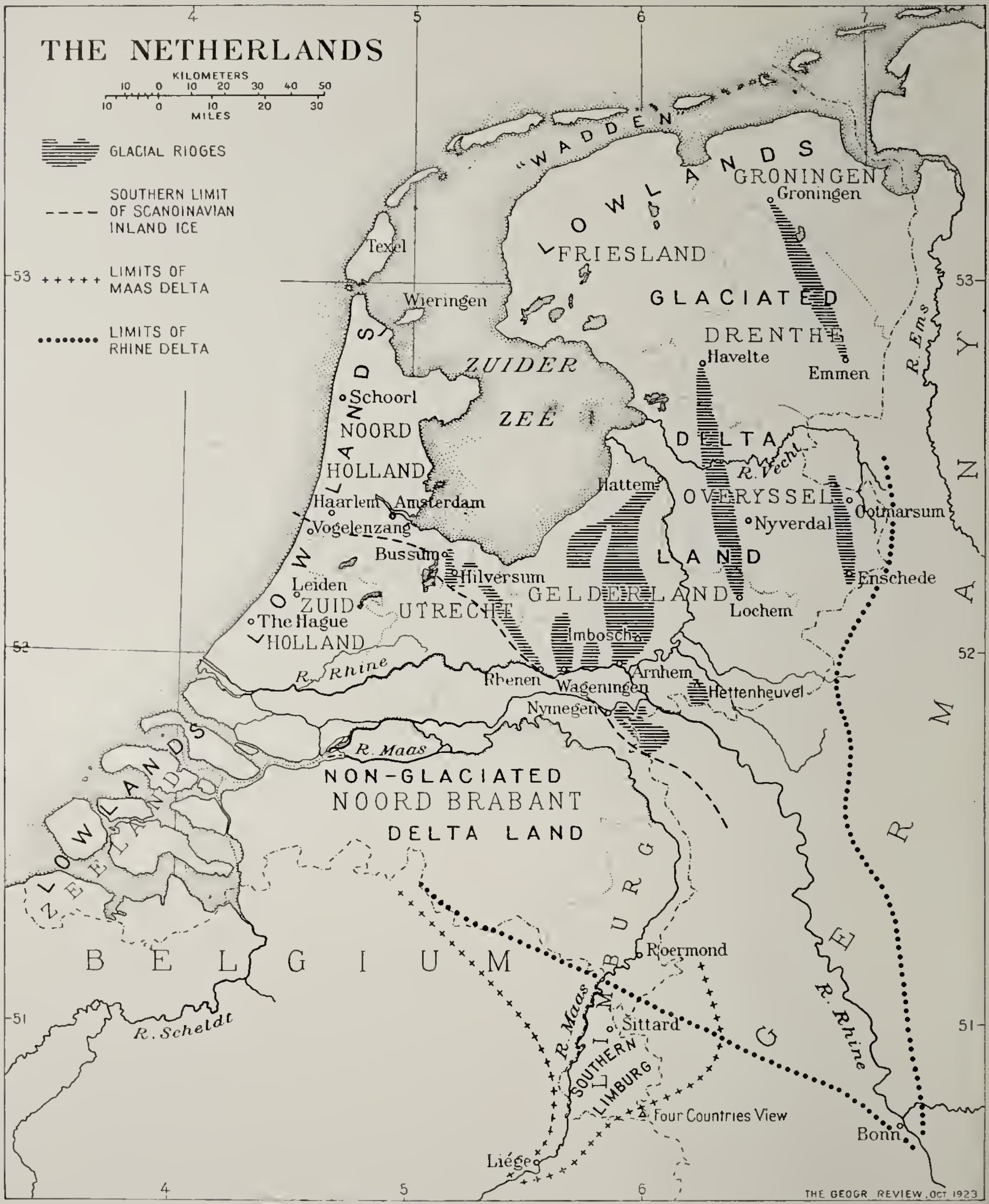

FIG. 1—Sketch map showing the physiographic divisions of Holland. Scale 1:2,500,000.

level and to transform lakes and swamps into cultivable land. In the sixteenth and seventeenth centuries many lakes and pools in the provinces of North and South Holland were drained. Since the introduction of large steam pumps, and later electric pumps, the *droogmaking* (making dry) has progressed further and more rapidly; for instance the "Haarlemmermeer" (lake of Haarlem), measuring 180 square kilometers, was drained in 1848-1852.

Up to the present, the greatest and most dangerous of all the Dutch lakes and bays has not yet been brought under man's control. The Zuiderzee, in Roman times a fresh-water basin ("Flevo lacus") in the middle of the peat land, communicating with the sea by one or more delta branches of the Rhine, greatly increased in size, becoming a real bay ("Almare") about 1300. The widened and submerged river valleys gave the tidal waves easy access to the interior of the bay. A number of years ago plans were drawn up for control of the area. The inner sea will be dammed by a strong dike running from Wieringen to the coast of Friesland and converted into four polders with a vast fresh-water lake between. In 1918 this important project had received government sanction, and works have already been started by which about 800 square miles (2100 square kilometers) of cultivable land will be added to Dutch territory.

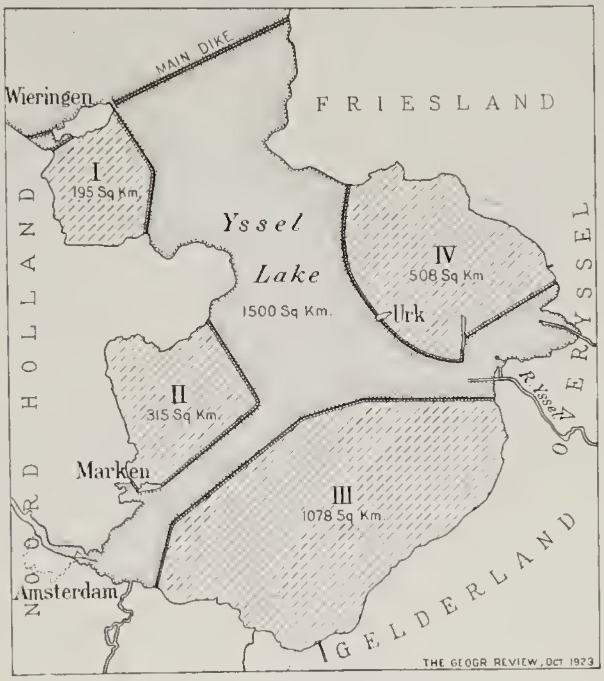

FIG. 2—Sketch map showing the project for damming the Zuiderzee and transforming it into four new polders and a fresh-water lake.

The complicated system of drainage in the polderland has given rise to a number of more or less independent councils and committees, constituted by persons who are directly interested in the watching of the water level and the upkeep of the dikes. The divergent interests of landowners in neighboring polders have always given rise to many difficulties and much litigation. In a country like the Netherlands the question of "ruling the waters" must always be of extreme practical importance and exigent of continuous survey.

While the lowlands is an essentially flat plain it nevertheless shows certain striking differences in altitude. The lowest parts are the bottoms of the ancient lakes, the *droogmakerijen*, where the peat layer has been wholly or partially destroyed by the waves or has been removed by man for fuel. The surface is four to six meters below the sea level and here the older estuarine clay outcrops. These former lakes are surrounded and intersected by areas where the peat bed is still preserved and where the surface of the ground is now one or two meters below sea level in consequence of the continuing change of level and the inevitable sinking of the dried soil. In the peat stems of trees are rather abundant, and their stumps are often found in a vertical position still rooted in the underlying floor of firm clay, the whole phenomenon showing again the recent change of level. On the other hand, in those parts which were formerly exposed to the invasion of sea water after the growth of the peat the latter is more or less destroyed and overlain by a newer estuarine clay, the altitude of which is the nearer the sea level of today the later the marshes have been embanked. Hence, as a rule, the older marshes in Friesland, Groningen, and Zeeland descend to a lower level than the newer ones.

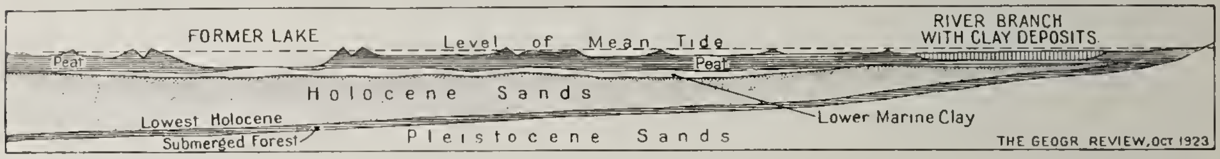

FIG. 3

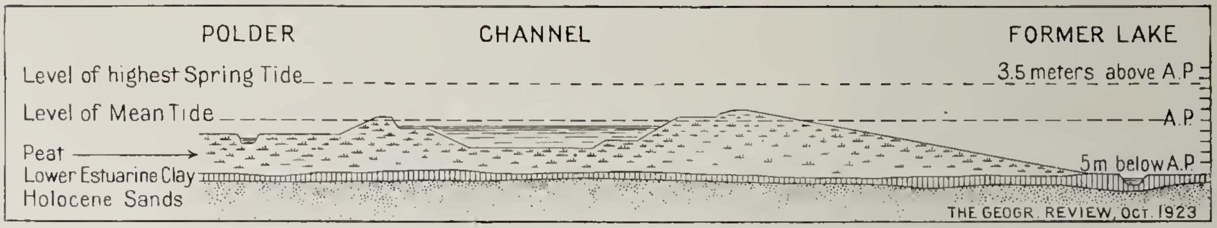

FIG. 4

FIG. 3—Generalized section across the polderland.

FIG. 4—Illustrating differences of level in the lowlands. Bank of former lake (droogmakerijen) with surrounding channel and neighboring polder. Province of South Holland.

The Coast with Chains of Sand Dunes

Existence of the former lagoon now converted into the lowlands suggests a sand barrier closing it from the open sea. After the disappearance of the isthmus between Dover and Calais some forty to ninety centuries ago, as we believe, the tidal currents of the English Channel circulated in the southern part of the North Sea, transporting large quantities of sands derived from the English and French shores and accumulated in the most easterly parts of the Channel. The direction of the tidal currents changes twice a day, but the movement of the water from west to east (current at high tide) is stronger than the returning current. The greater strength of the high-tide current is explained by the fact that it is reinforced by a branch of the Gulf Stream, by the prevailing west winds, and by the configuration of the Channel.

From this coincidence of circumstances resulted the growth of a sand barrier, starting from the spot to the west of Calais where the cliff (French *falaise)* ends, because the outcrop of Cretaceous strata turns southeastward. From this spot (Cape Blanc-Nez) the barrier extended farther and farther till it joined on to the solid glacial hills of the region of Wieringen and Texel which marked the other side of the wide and shallow bay.

Stages of Dune Formation

In the formation of the dune chains successive stages are to be distinguished. At the beginning a series of submarine sandbanks extending from Calais to Texel supposedly grew together in course of time, leaving openings where the river waters flowed out to sea. On these banks, consisting of sands mingled with many shells and fragments of shells, the first chains of sand dunes were blown up by the winds during low tide, bordered and fringed by an extensive beach on their northwestern side. It seems quite clear that this formation of dune chains must have been in process for a considerable time, the shore being advanced farther and farther seaward, and newer chains being formed at some distance from the older ones. In this way came into being a landscape of dune chains crossing and joining each other so as to enclose level stretches (parts of the former beach) between. This may be called the "old dune formation," and it dates back to times prior to 300 A. D. Its comparatively great age is proved by the fact that the upper parts of the sands have been depleted of lime by weathering, while lime is still present in the lower parts in the form of abundant small and worn fragments of the common shells. The basal bed of the wind-blown sand is a layer with accumulations of whole valves of the same shells, the former beach on which the dunes originated. This base is now found at a depth of three or four meters below the level of mean tide in the most easterly or oldest parts of the dune region and approaches gradually to the present level when we draw nearer to the present shore. This phenomenon shows again the continued rise of the sea level even in the last fifteen centuries.

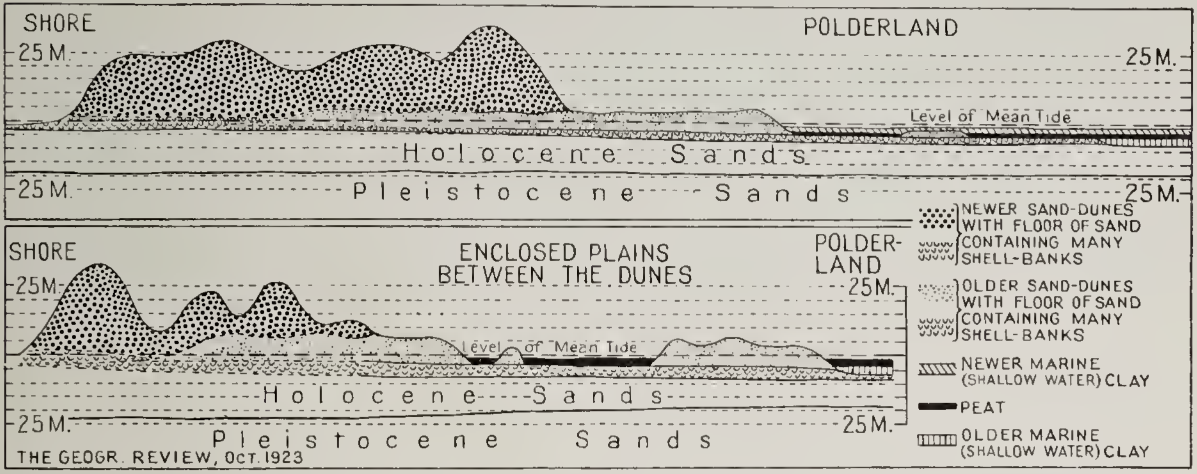
SHORE
POLDERLAND
25 M.
25 M.
Level of Mean Tide
Holocene Sands
25 M.
Pleistocene Sands
25 M.
SHORE
ENCLOSED PLAINS BETWEEN THE DUNES
POLDER-LAND
25 M.
25 M.
Level of Mean Tide
Holocene Sands
25 M.
Pleistocene Sands
25 M.
THE GEOGR. REVIEW, OCT. 1923
NEWER SAND-DUNES WITH FLOOR OF SAND CONTAINING MANY SHELL-BANKS
OLDER SAND-DUNES WITH FLOOR OF SAND CONTAINING MANY SHELL-BANKS
NEWER MARINE (SHALLOW WATER) CLAY
PEAT
OLDER MARINE (SHALLOW WATER) CLAY

FIG. 5—Sections across the coast chains of dunes; the upper section to the north of Haarlem, the lower section between Haarlem and Leiden. The vertical scale is 25 times the horizontal scale.

A new stage of dune formation commenced about the beginning of the fourth century. The date is determined by archeological evidence supported by the brief testimony to be found in the works of Roman writers. The circulation of the tidal currents depends upon the configuration and the depth of the Strait of Dover. As this feature undergoes slow and continuous alteration, so must also the direction of the sea currents and the configuration of the coast whose shores they wash. In some parts of the coast the old dune formation has been almost totally destroyed, the shore line retreating and a new dune formation being formed, resting on the new estuarine clay (polderclay) and the underlying peat beds of the lagoon. Such is the case in Belgium east of Nieuwpoort and in the adjoining parts of the Dutch coast. Farther to the north conditions do not exhibit a like change: seaward growth of the shore was continued, and recent dune chains border the old ones on their western side. This is the situation in the greater part of the provinces of North and South Holland. The recent dune sands have moreover been carried to the interior by the winds and locally overlie adjoining parts of the old dune formation with its enclosed plains; occasionally they may even have penetrated so far into the interior that parts of the lagoon have been overwhelmed by the fresh dune sands.

The Delta Land or "Highlands"

In contrast to the lowlands and the coast is the older and higher delta land of the south and east. This higher land is built up of deposits of Pleistocene age. It comprises the remainder of the country with the exception of the plateau of southern Limburg. Although described as "highland" the surface nowhere reaches 100 meters except in certain mounds of the glacial ridges in the province of Gelderland, as Imbosch (110 meters) and Hettenheuvel (105 meters). The non-glaciated south of the delta land, which includes the middle and northern parts of Limburg and the greater part of North Brabant, is to be distinguished from the glaciated north, and the wide valleys of the great modern rivers may be taken as a third subdivision.

THE NON-GLACIATED DELTA LAND

A line Nymegen-Wageningen-Utrecht-Vogelenzang marks the southern limit of the ice sheet. South of this line the terrain is composed exclusively of fluviatile deposits of southern origin. The lower deposits are coarse gritty sands with pebbles and boulders representing the principal or highest terrace of the Rhine-Maas system. They appear on the surface only on isolated blocks; for, owing to differential movements, this principal terrace has been depressed over large areas and covered by the newer deposits of the same rivers, sands without pebbles and with occasional layers of loam and clay. Except on the elevated blocks the thickness of the Pleistocene

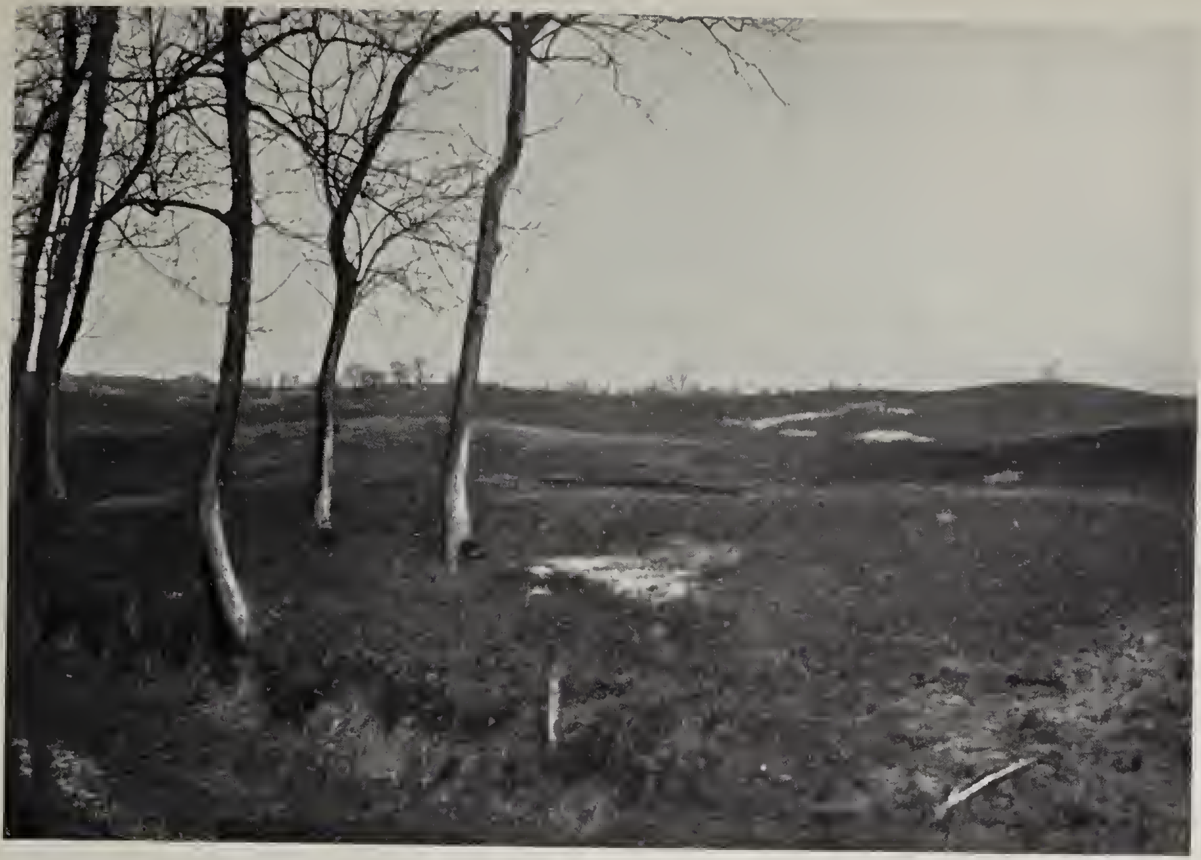

FIG. 6

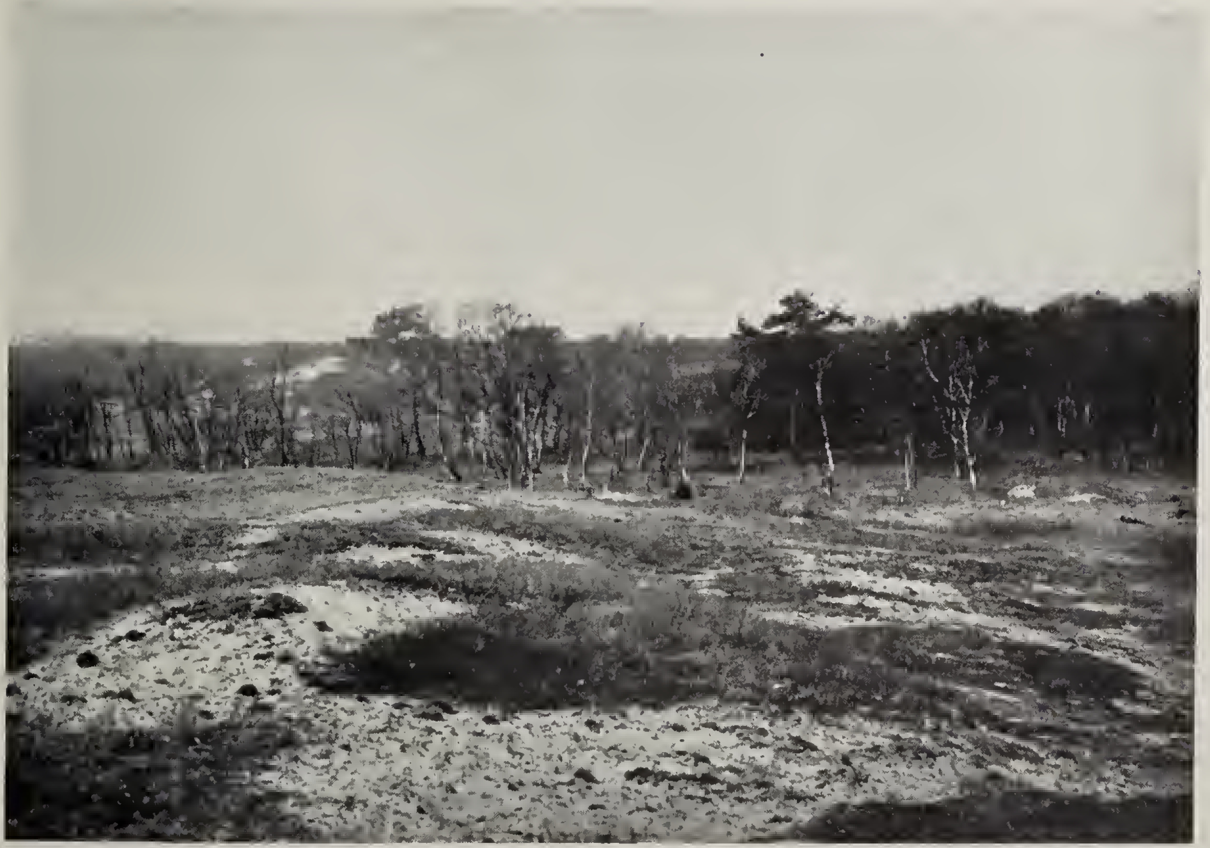

FIG. 7

FIG. 6—Old dune formation on the Netherlands coast. Grass-covered dunes between Haarlem and Leiden.

FIG. 7—Recent dune formation on the Netherlands coast. Plain with birch wood in the middle of the dunes between Haarlem and Leiden.

fluviatile sequence is everywhere more than 20 meters and in many cases surpasses 100 meters.

The surface shows an altitude slowly decreasing to the north and west and finally disappearing beneath the recent deposits of the lowlands. The landscape is a rather monotonous plain, broken in detail by areas where the sands have been blown up by the wind and also by a network of valleys of small rivers and insignificant brooks.

The Glaciated Delta Land

To the north of the before-mentioned land the Rhine-Maas delta has been overridden by the Scandinavian ice sheet which on its retreat left the typical morainal landscape that is met with in the provinces of Utrecht, Gelderland, Overyssel, Drenthe, Groningen, and Friesland. Fluviatile materials of southern origin have been superficially mixed with glacial materials of northern origin (derived from the rocks in the Baltic area and Fennoscandia) and contorted by the pressure of the advancing glacier front. In the northern provinces the ground moraine is a true boulder clay in which boulders of northern origin dominate; farther southward it loses more and more its northern character by the increasing proportion of constituents derived from the floor of fluviatile deposits of southern origin upon which it rests. In contact with Tertiary and Mesozoic strata, as is the case in the eastern parts of Overyssel and Gelderland, fragments of these rocks are also included.

Subsequent denudation has worn away the ground moraine in many places. Its normal thickness amounts to one to five meters, but locally the thickness is much greater (up to 16 meters). In some cases two or three layers of boulder clay occur separated by fluvio-glacial sands and gravels which probably indicate a slight oscillation of the glacier front.

Tangential compression of the ice sheet has produced several ridges of hills looking much like true terminal moraines. In the core of those hills, however, fluviatile materials of southern origin are found in disturbed and contorted condition, the lower parts of the slopes being locally covered by boulder clay or by an accumulation of northern boulders and for the rest by fluvio-glacial deposits. These latter under the form of extensive sand deposits are found widely distributed all over this part of the country, filling up the hollows between the hills. The five main ridges of glacial hills are marked by the localities: (1) from Emmen to Groningen; (2) from Enschede to Ootmarsum; (3) from Lochem to Havelte; (4) from Arnhem to Hattem; (5) from Rhenen to Bussum.

To the west of the fifth ridge the glacial deposits sink below the present sea level and are concealed by newer formations. In the province of North Holland glacial material has been proved in many borings southward to the latitude of Vogelenzang. On the islands of Texel and Wieringen it still occurs above sea level.

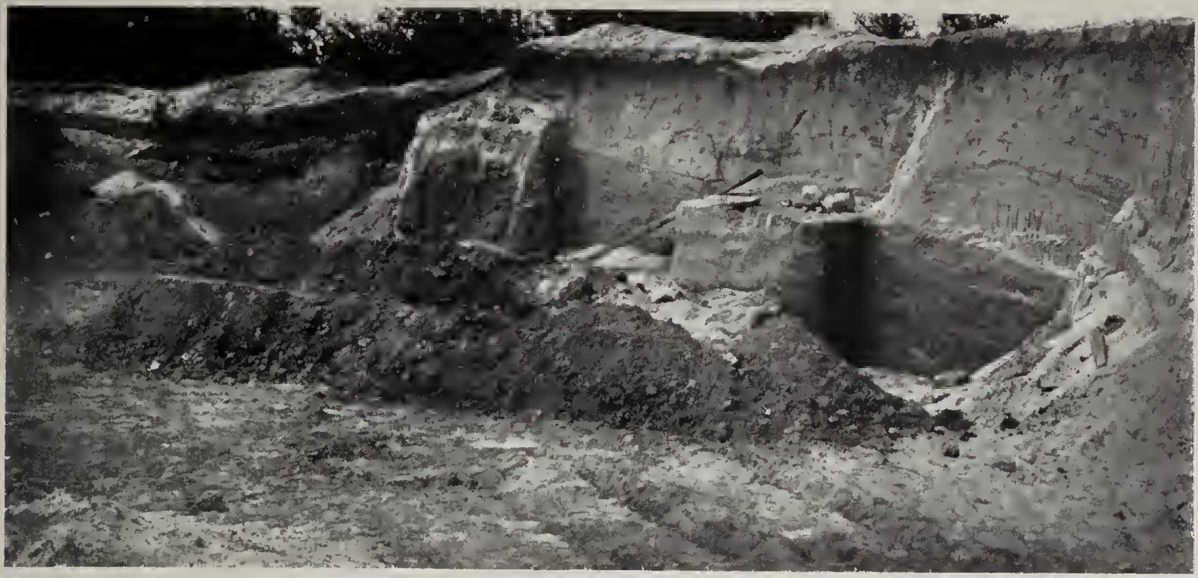

Fig. 8

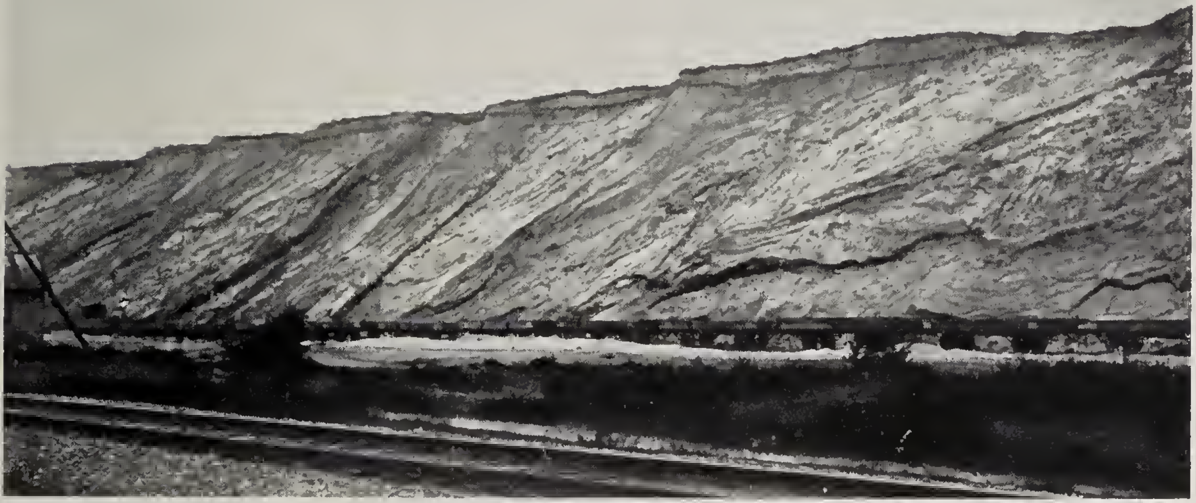

Fig. 9

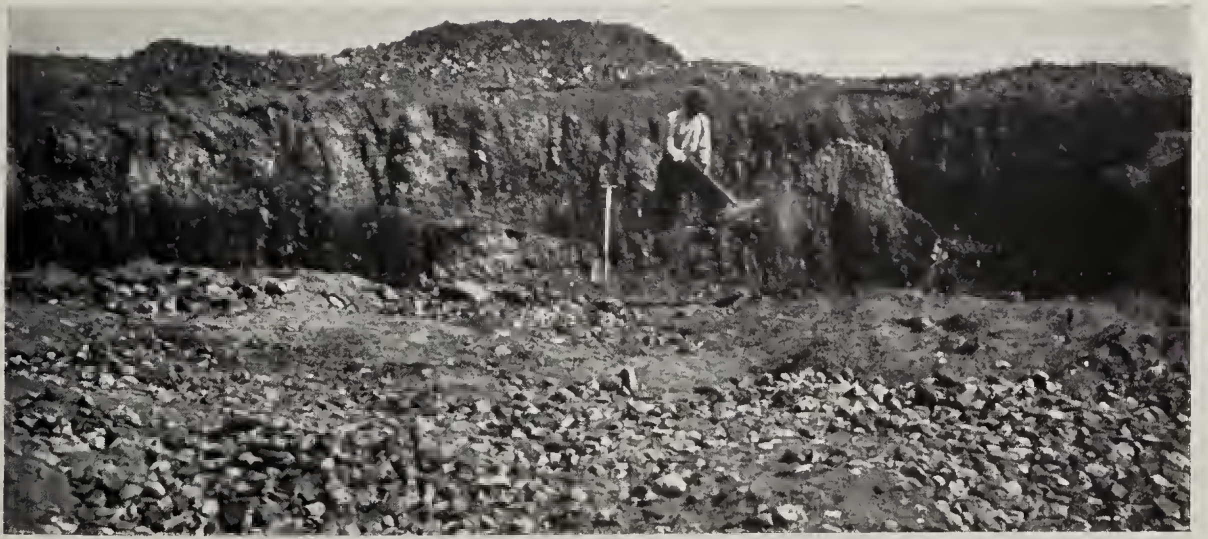

Fig. 10

Figs. 8–10—In the glaciated delta land of the Netherlands. Figure 8 shows ground moraine covered with beds of fluvioglacial gravelly sands between Hilversum and Bussum (North Holland). Figure 9 shows preglacial sands and clays contorted by glacial compression in railway cutting near Nijverdal (Overyssel). Figure 10 shows ground moraine with abundance of Scandinavian-Baltic boulders between Hilversum and Bussum.

Valleys of the Delta Land

Since the beginning of the present period the rivers have been excavating their beds anew in the soft Pleistocene sands, the level of which has been raised by the river deposits. In this way both glaciated and non-glaciated delta lands are now divided into sections separated by wide strips of river clay. These clay lands are intensely cultivated and are protected from inundation by big dikes. The diminished volume of water in the rivers after the termination of the Pleistocene period caused the disappearance of most of the ancient river branches and the creation of a less complicated delta network. The Scheldt shifted its bed farther westward; on the contrary, the Maas abandoned its western branches in North Brabant and withdrew to one of its eastern branches. The Rhine withdrew from the so-called "Geldersche vallei," the valley between the glacial ridges numbered 4 and 5. Thereafter deposition of the newest fluviatile clay commenced, for in all these postglacial beds true river clay is absent. In some of these erosion channels originated small rivers and brooks which gave rise to the formation of thin beds of sandy clay along their banks. In others a state of insufficient drainage favored the formation of moss peats. The moss peats in western North Brabant occupy former beds of the Scheldt, those in eastern North Brabant beds of the Maas (Peel region), and those in Overyssel and Drenthe the ancient channels of mighty fluvio-glacial streams now used by the rivers Vecht and Hunze.

The Plateau of Southern Limburg

This subdivision occupies a rather isolated position with respect to the rest of Dutch territory with the compact mass of which it is united by a narrow strip. Where the rest of the country is a combined Rhine-Maas delta, southern Limburg belongs exclusively to the Maas basin. This is shown on the map, Figure 1. The Maas delta is seen to begin at Liége; the Rhine delta, which begins at Bonn, crosses the Dutch frontier in the neighborhood of Roermond, that is north of southern Limburg.

On a floor of Upper Cretaceous and Tertiary strata a sheet of gravel has been deposited which now occupies the position of a comparatively high plateau, the principal terrace of the Maas. The Maas and its tributaries now flow here in entrenched valleys which locally enclose remains of an intermediate terrace and still lower the plain of the newest terrace with the recent river bed. In the valley slopes rocks of the older formations become visible; but, as the whole district except the lowest terrace and some small areas near the frontiers is covered by a rather thick layer of loess, the outcrops are in most cases more or less concealed.

The highest elevations of the Netherlands are to be found in southern Limburg where a good deal of the surface is enclosed within the 100-meter contour. The most elevated spot is the one where, before the war, the frontiers of four countries met: the Netherlands, Belgium, Prussia, and the neutral territory of Moresnet (now belonging to Belgium); this place is therefore called "Four Countries View" (322 meters).

In its deep sinuous valleys with wooded slopes and not infrequently rocky walls and swift-flowing streams, its loess-covered interfluves so excellently adapted to grain cultivation, southern Limburg presents an entirely different landscape from the rest of the country. Geologically and physiographically it pertains to the plateau bordering the northern Ardennes. So, too, is it in the matter of economic resources and potential economic development. The surface outcrops of coal at Kerkrade have long been worked on a small scale. Recently, following an extensive series of explorations by which the geological structure has become known, exploitation of the coal field of southern Limburg has begun on a large scale. The Upper Carboniferous formation, upon which the posterior formations lie unconformably, has been folded in Permo-Carboniferous times (Hercynian or Variscan-Armorican folding). A system of major faults, running about southeast-northwest, divides the whole district into blocks in which the depth of the Carboniferous varies from 60 to 600 meters and still more. The numerous faults have greatly affected even the most recent formations and are revealed in the configuration of the surface. In spite of such disturbances, however, the general character of a plateau with deep valleys is fairly well conserved downstream as far as Sittard.

At present coal is worked in nine mines, three of which are owned by the Government and six by private companies. The annual output of this field has now (1921) reached 4,000,000 metric tons, production having rapidly increased during the Great War. Calculation of the available coal resources has given a figure of about 3000 million tons. Lignite, chalk, clays, and glass sands are other minerals which are, or have been, worked in southern Limburg.

THE RAINBOW BRIDGE, UTAH *

By H. D. Miser, K. W. Trimble, and Sidney Paige
U. S. Geological Survey

The Rainbow Bridge, a graceful natural arch of sandstone high enough to span the dome of the Capitol at Washington, surpasses in size and symmetry any other known natural bridge. It is in the former Piute Indian Reservation, in San Juan County, southern Utah, more than 150 miles from a railroad, and can be reached only by traversing in boat the long canyons of the swift Colorado and San Juan Rivers or by traveling with pack train the few and little-used trails.

The Surrounding Country

The arid country adjacent to the bridge is a part of the broad Colorado Plateau, yet it is so dissected by the streams as to be nearly inaccessible, and practically none of its surface is level. The intercanyon areas are characterized by numberless remnants of erosion—large, closely spaced mounds, domes, and "mosques" of bare sandstone—which rise as much as 1000 feet above the canyon floors, or 4500 to 5000 feet above sea level.[1] Above this expanse of rugged canyons and domes, four miles southeast of the bridge, towers the solitary peak of Navajo Mountain to an altitude of 10,416 feet; and on the western side of Colorado River the east end of the broad and steep-faced Kaiparowits Plateau reaches an altitude of 7500 feet.

In the canyons a variety of shrubs and scanty patches of grass flourish among the yellow sand dunes; but on the higher parts of the country the soil is swept away by wind and rain as fast as it is formed, and only small clumps of grass and sage brush are able to maintain a foothold. The buff, tan, and red colors of the almost unbroken expanse of bare rock contrast sharply with the dark green of the dense coniferous forests on Navajo Mountain.

The Bridge Canyon

The Rainbow Bridge may be seen from the lofty summit of Navajo Mountain, from which it appears as a tiny arch; in spite of its large size it is not conspicuous in a landscape view across the country, for it is well hidden in the bottom of a canyon 500 to 1000 feet deep. The canyon is so crooked and so narrow—the precipitous walls in places being less than 100 feet apart—that some of its stretches are lighted by sunshine during

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* Published by permission of the Acting Director of the U. S. Geological Survey. The authors are indebted to the following persons for assistance: J. H. Renshawe, M. R. Campbell, B. H. Lane, C. A. Weckerly, and E. C. La Rue of the U. S. Geological Survey and W. B. Douglass of the U. S. General Land Office.

[1] Cf. the article by H. E. Gregory: The Navajo Country, *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 561–577 and 652–672.

only a small part of the day. Near the bridge the walls are several hundred feet apart, yet the traveler who is approaching the bridge along the canyon floor is unable to see it until he reaches a point less than half a mile away. When the bridge finally bursts into view its great height is dwarfed by the still greater height of the vertical canyon walls, and its massive proportions cannot be fully realized until the visitor passes under the bridge and gazes at it from below.

THE BRIDGE

The arch of the bridge projects in a northeastward direction from a large bare dome of sandstone on the southwestern side of the canyon and spans a narrow inner canyon which has been cut by Bridge Creek in the older and broader canyon floor. It attains a height of 309 feet above the creek and 235 feet above the top of the inner canyon and has a span of 278 feet.[2] The thickness and width of the arch at its highest point are 42 and 33 feet, respectively, and these dimensions are not greatly exceeded by those of the haunches. The inside of the west abutment is 74 feet above the stream, but the inside of the east abutment, where the notebook containing the signatures of visitors is kept, is 20 feet higher. The haunches are so steep that the bridge cannot be used for crossing the canyon. The only way to reach the top is by climbing the canyon wall a short distance below the southwest haunch, thence descending by rope from the crest of the sandstone dome over a 50-foot cliff. Bridge and canyon walls display shades of buff, tan, and reddish-brown and in places are striped with vertical tapestry-like bands of light and dark gray. (Fig. 6) The rainbow form of the bridge, which is apparent at every point from which the arch may be seen, has been recognized by the Piute Indians and suggests to them the

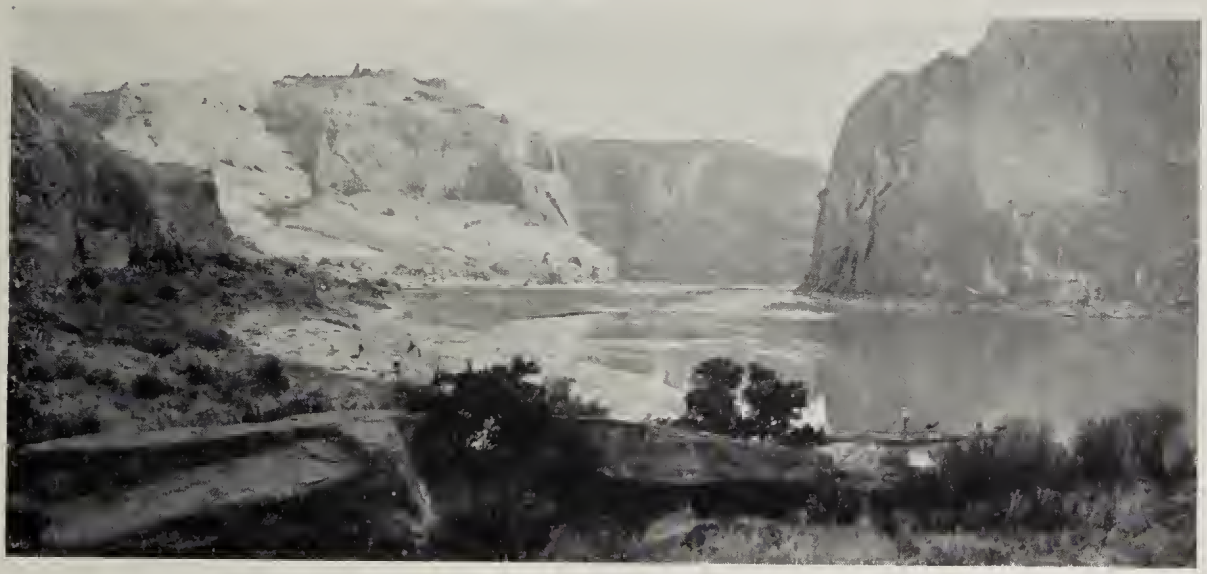

FIG. 1—A downstream view of the canyon of the Colorado at the mouth of Aztec Creek. Aztec Creek enters the Colorado from the left 300 yards beyond the men in the left foreground (compare the map, Fig. 2). (Photograph by E. C. La Rue.)

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[2] The measurements of the bridge were made by W. B. Douglass with a steel tape.

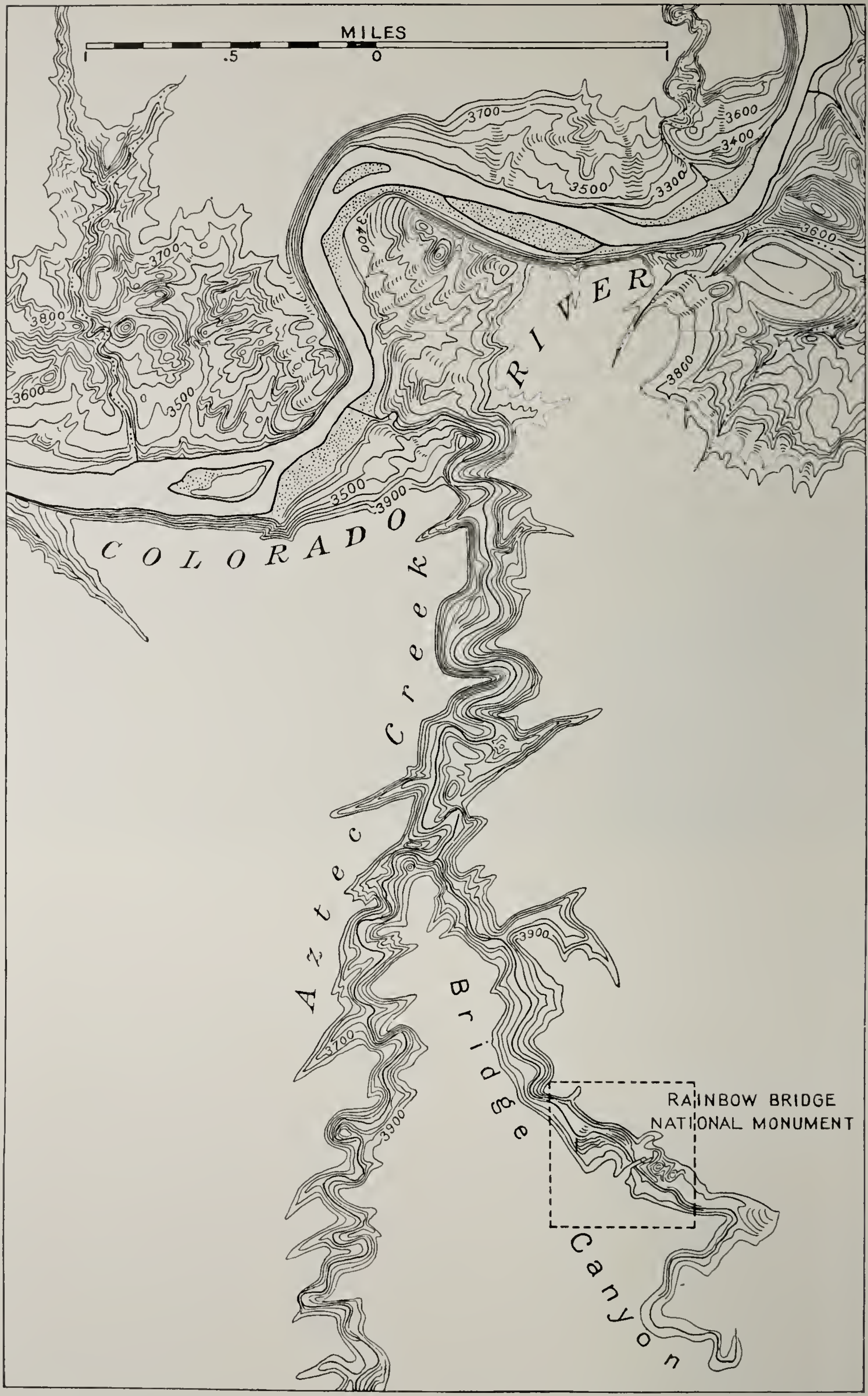

FIG. 2—Contoured map showing the position of Bridge Canyon and the Rainbow Bridge National Monument in relation to Aztec Creek and the Colorado River. (Drawn from the U. S. Geological Survey's map of the Colorado and San Juan Canyons, 1923. For orientation see map, Fig. 3.)

name Barohoini, a rainbow. To the Navajo Indians the form suggests the name Nonnezoshi, meaning "a hole through a rock". The Indians have, however, not applied either of these names to the bridge.

ORIGIN OF THE BRIDGE

The bridge and the deep canyon that contains it have been carved from nearly horizontal beds of sandstone by normal agencies of erosion. The inner canyon has been eroded in large part in a comparatively thin-bedded reddish-brown sandstone (Todilto) of Jurassic age. The exposed ledges are rough and platy. The bridge and the high adjoining walls, on the other hand, are composed of an exceedingly massive sandstone (Navajo, also of Jurassic age) whose exposed surfaces are generally smooth and well rounded. The single solid mass of sandstone composing the bridge is firm and yet soft enough to be easily crushed under the blow of a hammer. The bed of sandstone from which this mass has been carved is revealed in the high adjacent canyon walls, where its total thickness is apparently the same as the height of the walls, that is about 750 feet. No well-marked bedding planes are visible in the walls, but long cross-bedding planes dipping toward the north are a conspicuous feature. Cross-bedding on this huge scale, as well as the uniform small size and roundness of the sand grains and the massiveness of the sandstone, is generally regarded as indicating that the sand of which the rock is formed was deposited by wind in giant sand dunes on an ancient desert. The sand of the comparatively thin-bedded Todilto formation, in the inner canyon, was probably laid down in water. These sandstones dip about 100 feet to the mile toward the Colorado River, 4.6 miles to the northwest. The Navajo sandstone appears not only in the walls of these minor canyons but also in that of the major canyon of the Colorado and is exposed in large areas between them, where the numerous

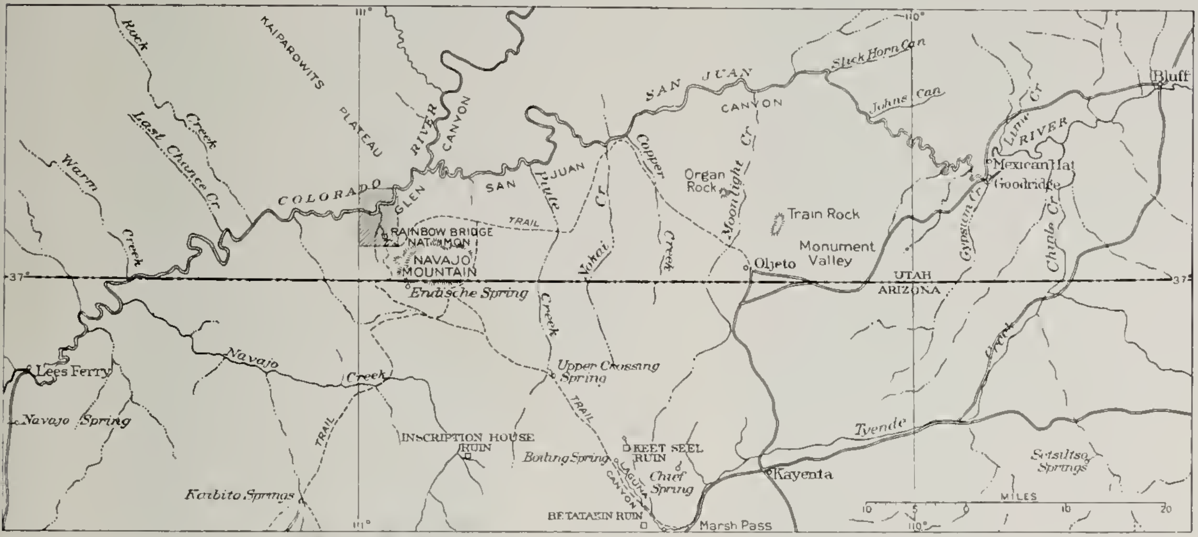

FIG. 3—Sketch map showing routes to Rainbow Bridge. The shaded rectangle represents the area shown in Figure 2.

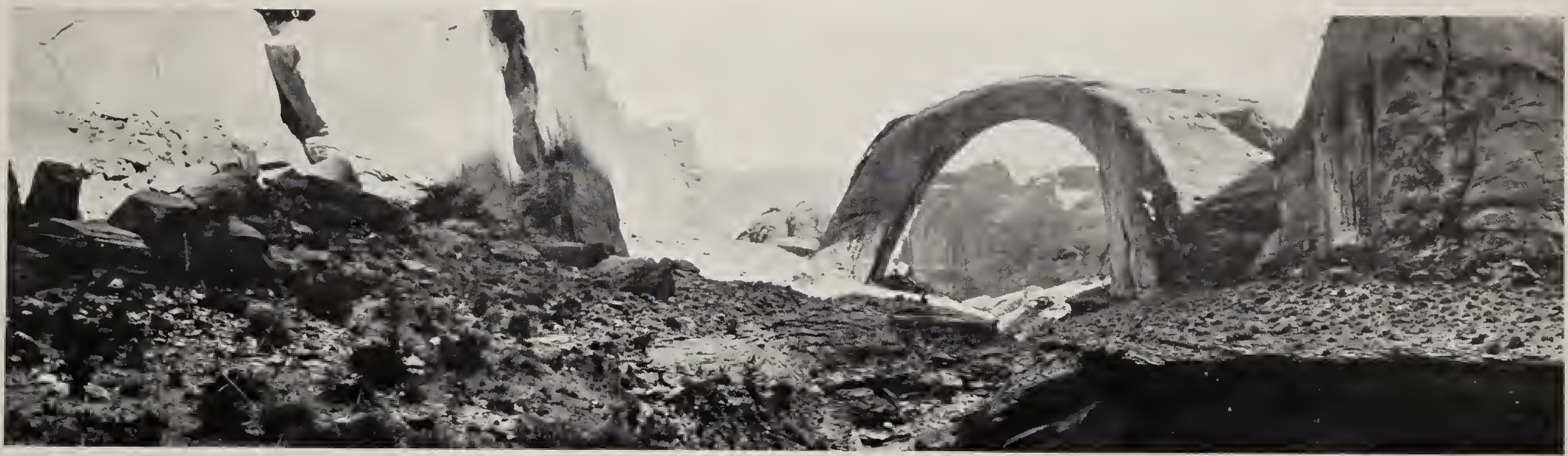

Fig. 4

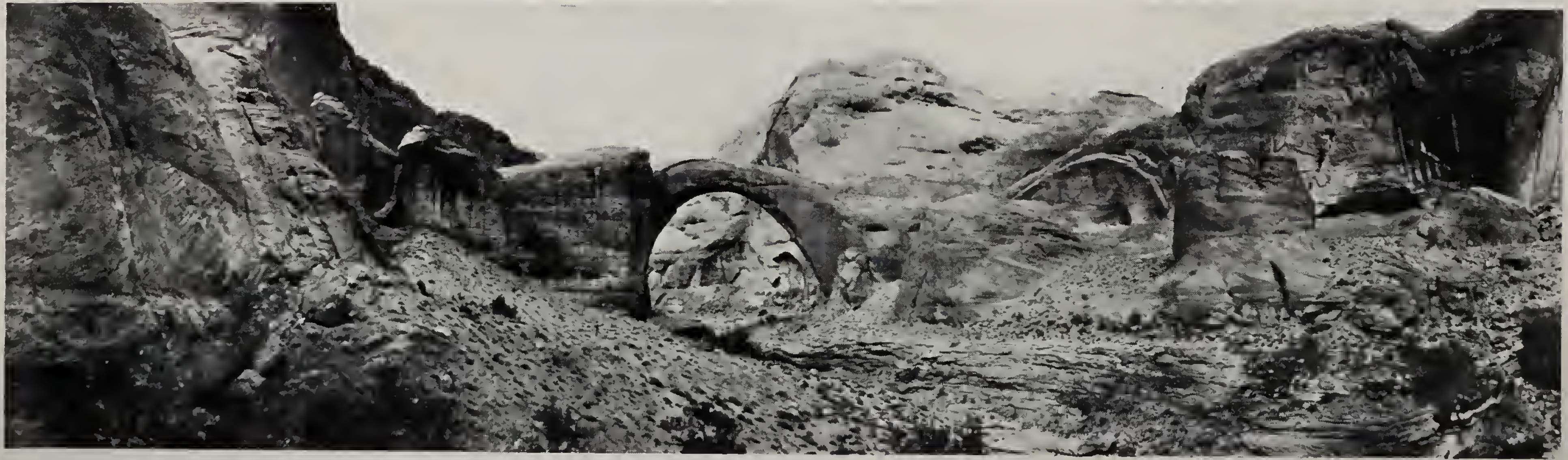

Fig. 5

Figs. 4 and 5—Views of Rainbow Bridge. The bridge projects as a graceful arch in a northwestward direction from the crest of a large bare dome on the southwest side of the canyon and spans a narrow inner canyon in which runs Bridge Creek. Figure 4 is looking up the canyon. The foreground is darkened by the shadow of the south canyon wall. Figure 5 is looking down the canyon. (Photographs by E. C. La Rue.)

bare, closely packed domes or "mosques," already mentioned, have been carved from it by erosion.

Bed rock with water-filled potholes can be seen along much of the channel of Bridge Creek, but it is concealed in places by small bars of sand, rounded pebbles, and huge boulders. More extensive deposits of stream-laid materials, consisting of fairly well rounded pebbles, cobbles, and boulders of sandstone, form a mantle many feet thick on narrow shelves or benches that stand above the inner canyon, at the base of the main canyon walls. These materials occur on both sides of the canyon, but on the south side they are less abundant and are concealed for the most part by sand dunes. The character and position of these deposits indicate that they were laid down by Bridge Creek when it was a sluggish stream flowing in a channel that was 130 to 140 feet above the present rapid-flowing stream. This old gravel-filled channel now stands about 550 feet higher than Colorado River at the mouth of Aztec Canyon, and it was probably occupied by ancient Bridge Creek when the canyons of Colorado and San Juan Rivers were 400 feet shallower than they are now. Since then the rivers renewed the deepening of the canyons, cutting them to their present depth and leaving some of the old gravel-covered canyon bottom as terraces on both sides of the present streams. Such terraces may be seen along the San Juan and the Colorado above the mouth of Aztec Creek. These rivers apparently flowed at this high level during one of the interglacial epochs. The deposits of ancient Bridge Creek may therefore have been laid down during the Glacial period.[3]

Both the distribution of these high-level water-laid materials in Bridge Canyon and the shape of the canyon walls show that ancient Bridge Creek, when it deposited these materials, pursued a very crooked course, flowing in several oxbow loops in the vicinity of the bridge. Where the loops impinged against the canyon walls concave notches were cut in the cliffs of the massive Navajo sandstone; between the notches sandstone spurs projected from the cliffs. Some of these notches and spurs may still be seen (Fig. 8). That the bridge was once a spur projecting from the south canyon wall into an oxbow loop of the stream is clearly indicated by the water-laid deposits of the ancient Bridge Creek which extend around the north end of the bridge at H and also skirt the base of the adjacent notch in the cliff. Ancient Bridge Creek, aided by weathering, undercut the walls in the canyon notches, forming vast well-rounded recesses or niches known as alcoves. The undercutting of the canyon walls was due in part to the removal of the sand grains after they had become loosened by weathering, but mainly to the breaking away by exfoliation of large and small slabs of rock from the faces of the cliffs. The Navajo sandstone is so massive and even-textured that slabs break off irrespective of the direction of the cross-bedding planes and leave smooth-rounded surfaces similar to those formed by the breaking of blocks of slag or glass.

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[3] Oral communication from Kirtley F. Mather.

Alcoves are characteristic features of the cliffs of the Navajo sandstone (Fig. 10), not only in Bridge and Aztec canyons but in many other canyons of the Colorado Plateau, but not all of them are formed by stream undercutting. Most of them are formed above seeps or springs at the base of the sandstone and also beneath waterfalls. In such places the upper parts of the cliffs of the Navajo sandstone, which is less resistant than the sandstone of the Todilto formation, are undermined. Some alcoves like those at A, B, C, and D on the map (Fig. 8) have smooth concave walls resembling the walls of a huge hollow sphere, but many have arched roofs and vertical back walls.

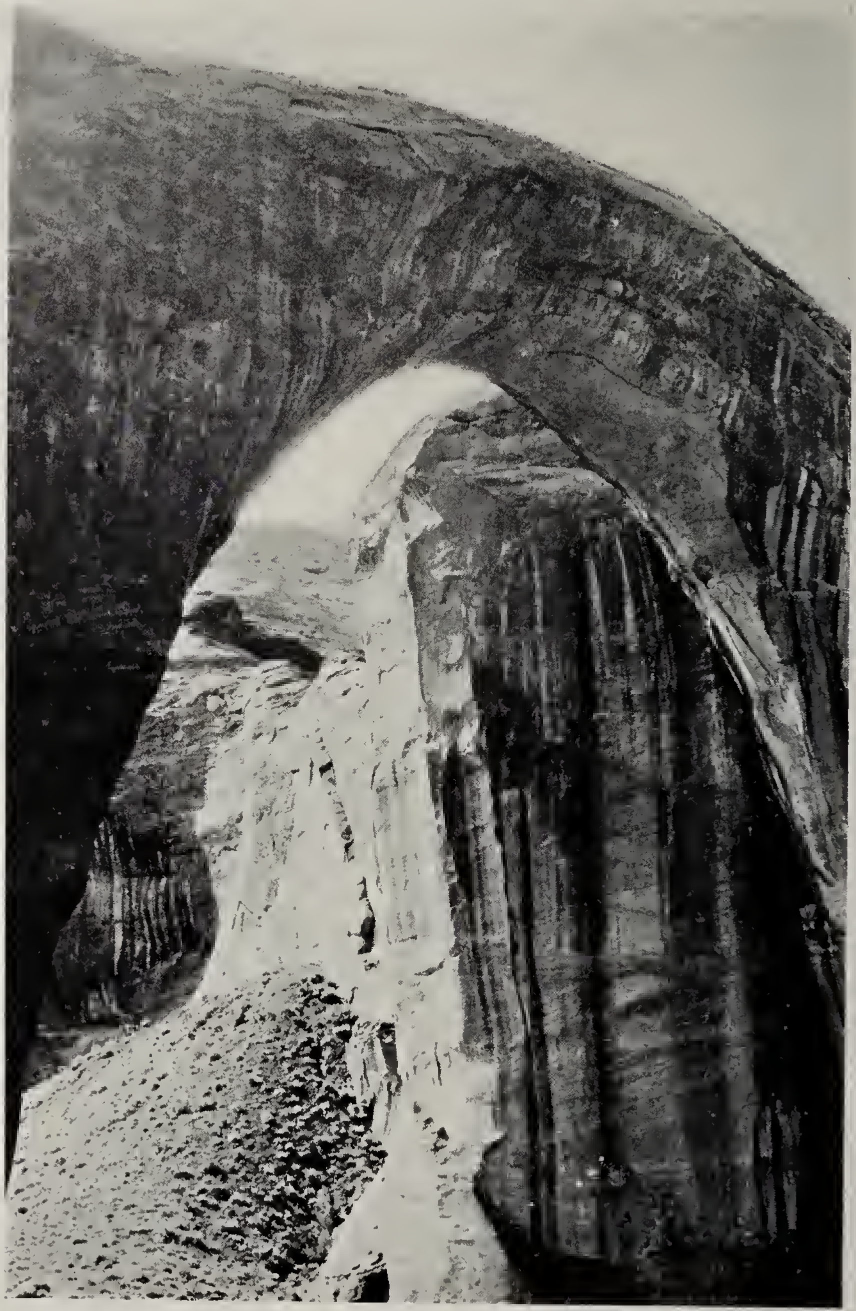

Fig. 6—A close view of Rainbow Bridge from the north. Bridge and canyon walls display shades of buff, tan, and reddish-brown and in places are striped with vertical tapestry-like bands of light and dark gray. (Photograph by E. C. La Rue.)

Alcoves with arched roofs were doubtless formed on both sides of the Rainbow Bridge spur, and, when they had approached each other closely enough, an opening was cut through the spur. Then the stream, instead of flowing around the spur as before, found its way through the opening and has since eroded the present inner canyon, which is 130 to 140 feet deep below the gravel-covered benches. The trend of the sandstone spur and also of the bridge may have been influenced by nearly vertical northeastward-trending joints in the sandstone. Such joints, though only a few were observed near the bridge, are numerous in Aztec Canyon, whose course they control to some extent.

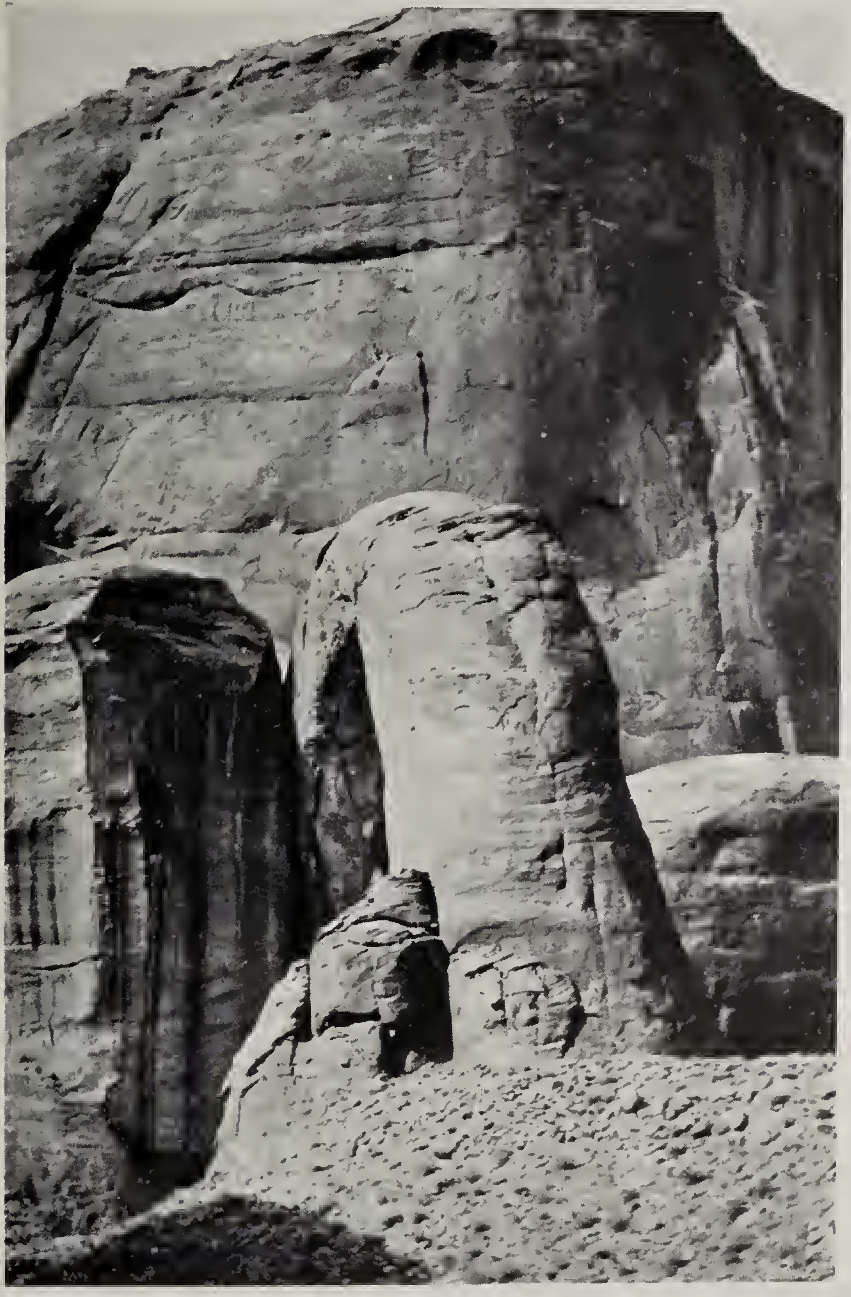

FIG. 7—An end view of Rainbow Bridge from the northeast, showing the peeling of slabs of sandstone from its surface. The water-laid deposits of the ancient Bridge Creek extend around the near end of the bridge. (Photograph by Sidney Paige.)

The bridge may have first come into existence during the Glacial period. At any rate the event took place many thousands of years ago, as measured by the probable time required for the eroding of the present inner canyon. From time to time sheets or slabs of sandstone have peeled from its surface and fallen to the bottom of the canyon, and sand grains that have become loosened by weathering have been carried away by wind and rain. Although these processes have gradually increased the span of the bridge and diminished the diameter of the immense sandstone cylinder that forms it, the bridge is still of substantial proportions and will, under present climatic conditions, stand for many centuries.

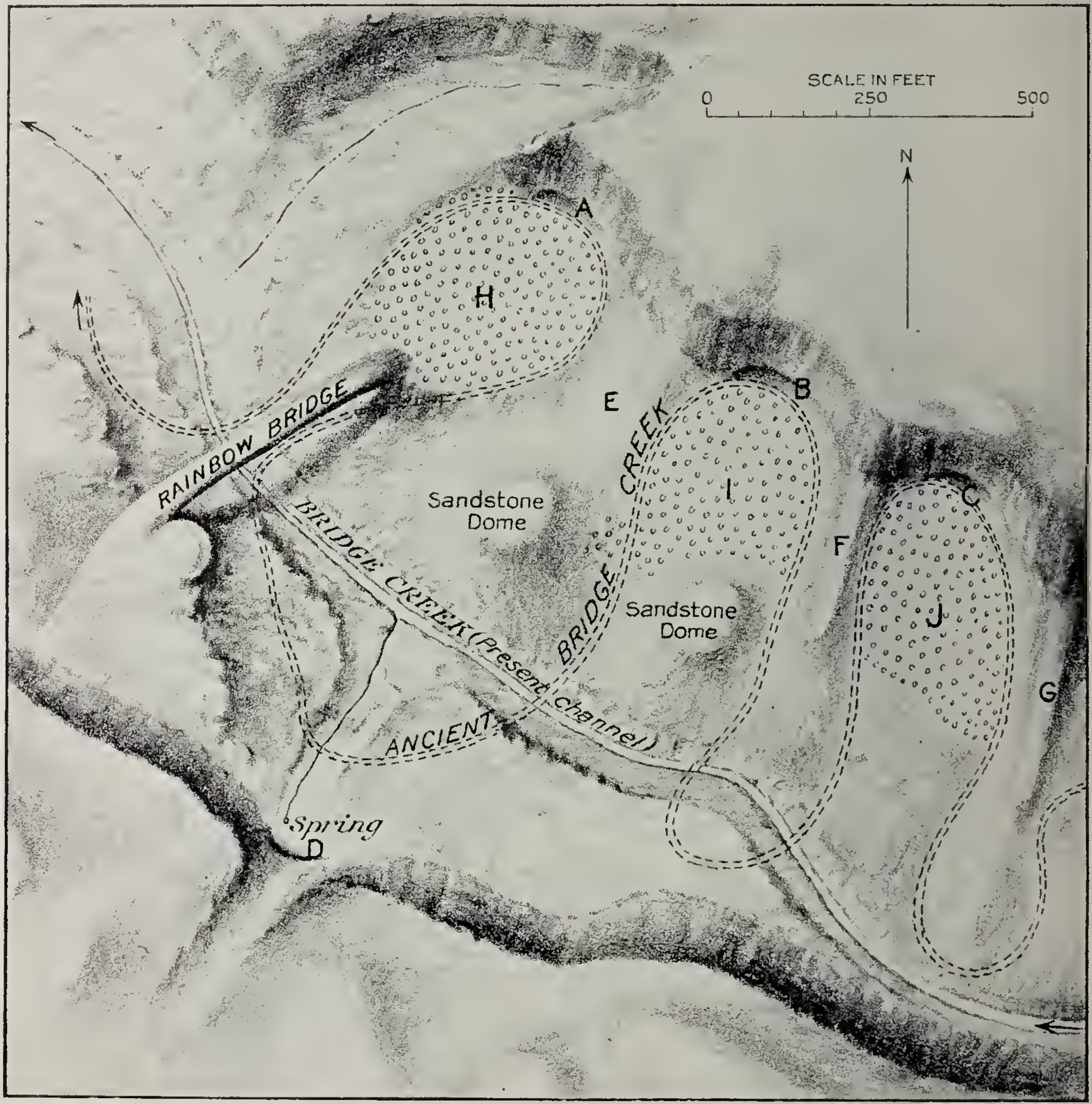

FIG. 8—Diagrammatic map of Rainbow Bridge, showing the deposits and course of ancient Bridge Creek. A, B, C, and D, notches and alcoves in canyon walls; those at A, B, C, and possibly D, were cut by the impinging of ancient Bridge Creek against the canyon walls E, F, and G, sandstone spurs that extended into loops of ancient Bridge Creek. H, I, and J, benches underlain by the deposits (represented by small circles) of ancient Bridge Creek. (Map drawn by C. A. Weckerly.)

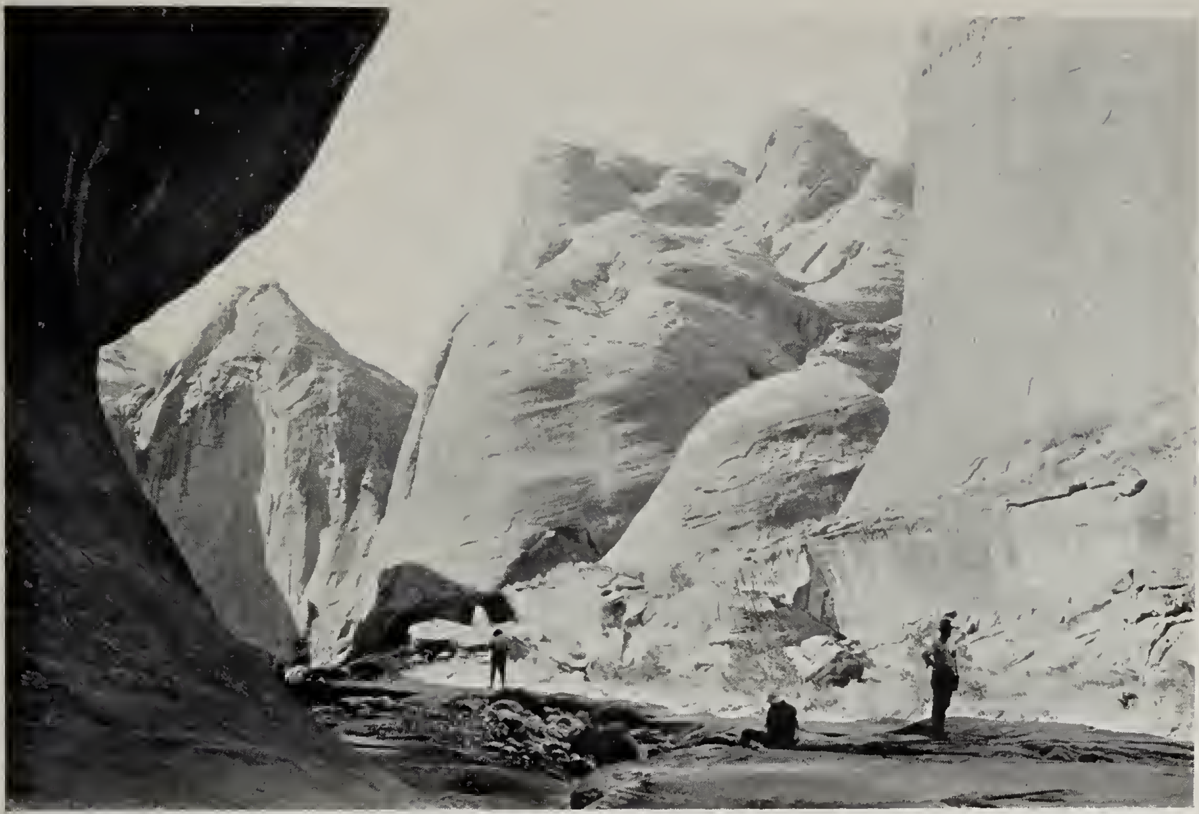

Fig. 9

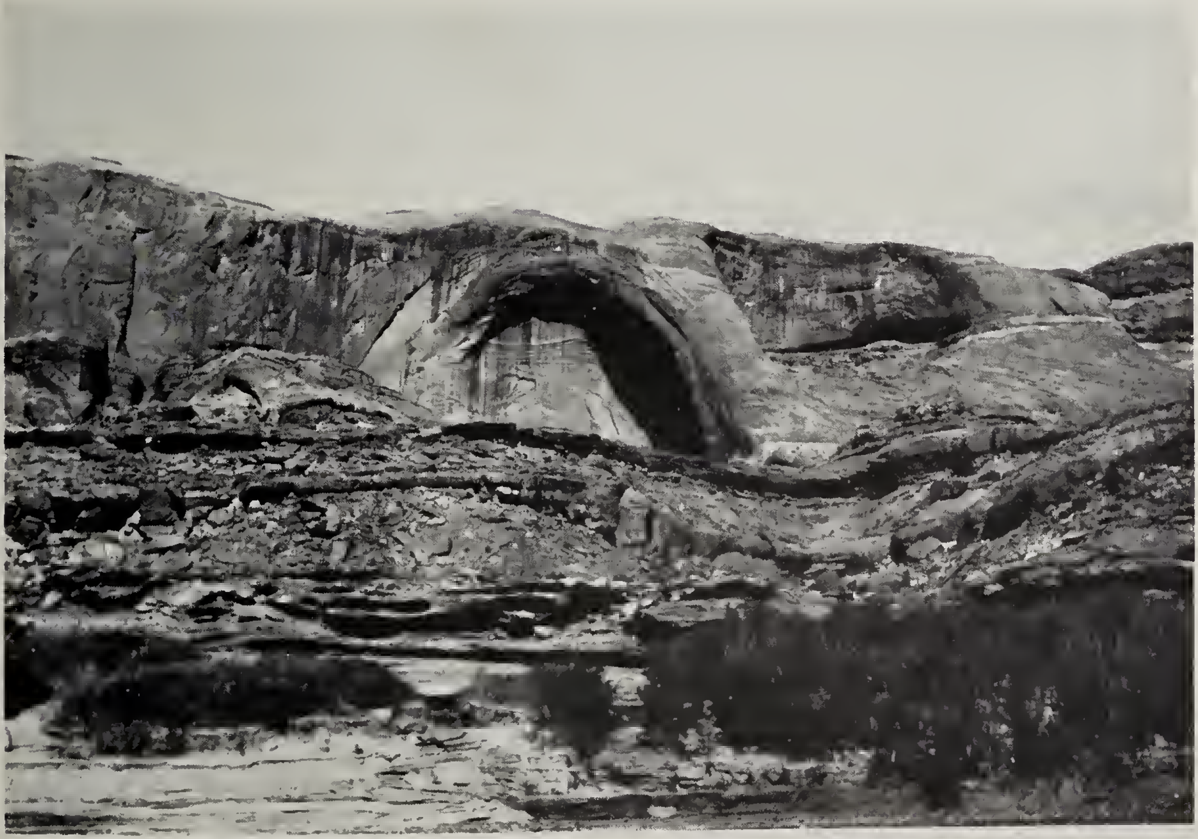

Fig. 10

Fig. 9—View looking up Aztec Creek on the way to Rainbow Bridge from the Colorado River. The canyon walls and gigantic domes, many hundred feet high, are composed of massive Navajo sandstone. (Photograph by E. C. La Rue.)

Fig. 10—Canyon walls of the Colorado River above the mouth of the San Juan River. Alcoves, with arched roofs, are characteristic features of the cliffs of Navajo sandstone. The junction of two such alcoves on opposite sides of a spur would result in the formation of a natural bridge. (Photograph by Sidney Paige.)

The above explanation of the origin of the bridge accords with briefer explanations already advanced by Cummings, Pogue, and Gregory.[4]

DISCOVERY OF THE BRIDGE

On account of the inaccessibility of the region the bridge was not seen by white men until 1909, and since then it has been visited by only about 250 people.[5]

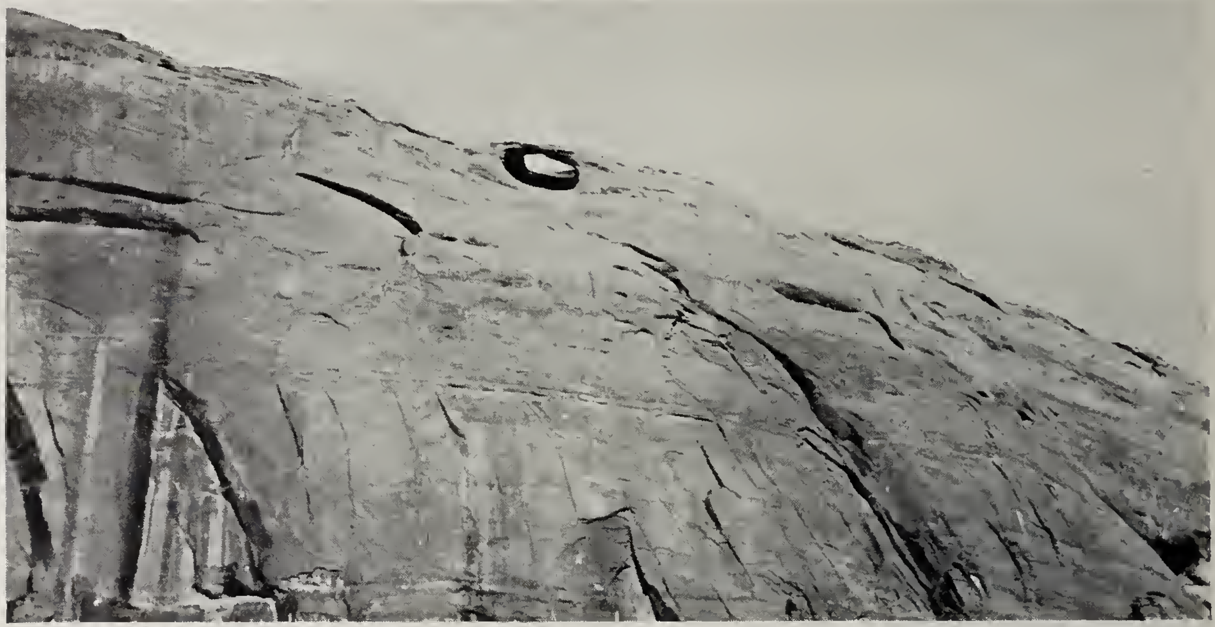

FIG. 11—One of several known natural bridges occurring in the same sandstone as that forming Rainbow Bridge. This bridge, in San Juan Canyon 3 miles below Piute Creek, has an estimated span of 50 feet and stands on the inaccessible rim of the canyon. It has apparently been formed by the partial collapse of the roof of a cave. (Photograph by H. D. Miser.)

While W. B. Douglass of the United States General Land Office was surveying the three large natural bridges in White Canyon, San Juan County, Utah, in 1908, he was told by a Piute guide of a great sandstone arch of rainbow shape near Navajo Mountain. He attempted to reach the bridge in December but failed on account of the snow. The following year (1909) a combined party of white men and two Piute guides under charge of Douglass and Byron Cummings succeeded in reaching the bridge on August 14.[6] The trip was made by pack train from Bluff, Utah, via Oljeto down Copper Canyon to San Juan River, across Nokai and Piute canyons, and along the north flank of Navajo Mountain to Bridge Canyon.

Douglass made another visit in October, 1909, on which occasion he completed a survey of the bridge and the proposed national monument, consisting of a square tract of 160 acres including the bridge. On May 30, 1910, this tract was set aside by proclamation of President Taft as the Rainbow Bridge National Monument.

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[4] Byron Cummings: The Great Natural Bridges of Utah, *Natl. Geogr. Mag.*, Vol. 21, 1910, pp. 157–167.

J. E. Pogue: The Great Rainbow Natural Bridge of Southern Utah, *Natl. Geogr. Mag.*, Vol. 22, 1911, pp. 1048–1056.

H. E. Gregory: Geology of the Navajo Country, *U. S. Geol. Survey Professional Paper 93*, Washington, D. C., 1917, p. 135.

[5] Estimate by Ellsworth Kolb, October, 1921.

[6] The account of the discovery here given is taken from W. B. Douglass' field notes, which are filed with the official records of the U. S. General Land Office.

Very few Indians and no white people live in the country around the bridge, for there is no game and practically no soil for the growing of grass or crops. The nearest known Indian settlement consists of about a dozen Piutes who live in the canyon of Nasja Creek, some five or ten miles to the east or northeast. A few nomadic Navajos live in Piute Canyon, which extends northward past the east base of Navajo Mountain. But the total number of Indians living within a distance of 15 miles in all directions from the bridge is probably much less than 100.

To what extent the bridge was known to the present-day Indians before it was visited by white men is not known. The Piute Indian guide told Douglass that only one other Indian besides him knew of its location. A pile of stones under the bridge on the north side of the creek is said by Douglass to have been a prehistoric altar at which the cliff dwellers probably worshiped the bridge. Douglass also states that White Horse, a Navajo Indian, after passing under the bridge, would not retrace his steps but laboriously climbed over a steep boulder-strewn slope to pass around the north end. White Horse had evidently forgotten the prayer that the Navajos believe they are required to utter under penalty of death before they retrace their steps beneath an arch which to them represents the rainbow or sun path.

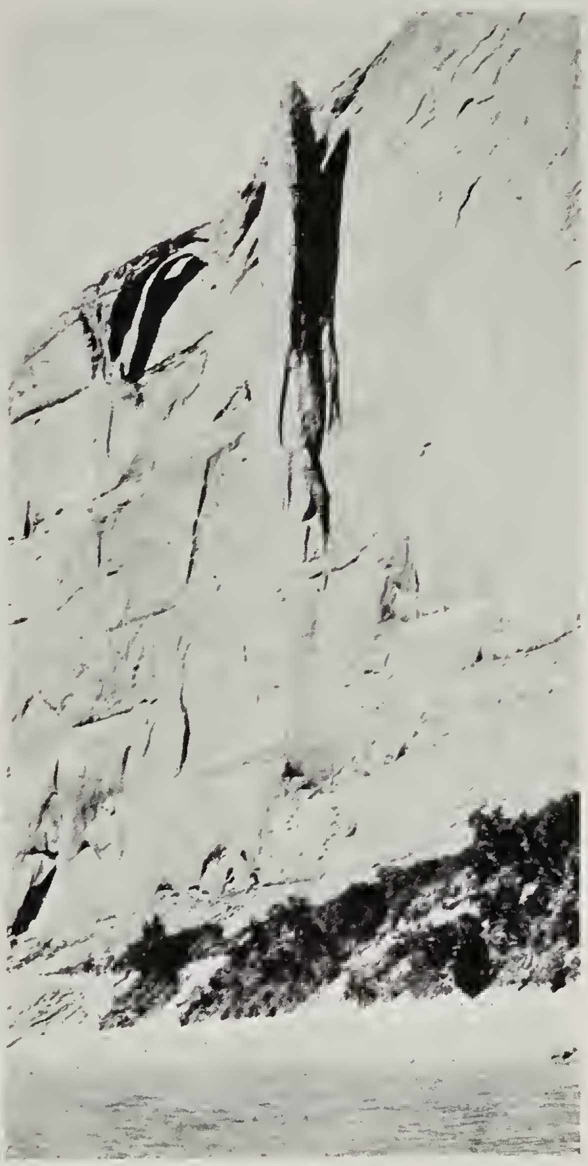

FIG. 12—Another natural bridge in the same sandstone as that forming Rainbow Bridge. This bridge is on the rim of the Colorado Canyon wall 700 feet high, 6 miles below the mouth of the San Juan River. Viewed from a boat descending the Colorado. (Photograph by E. C. La Rue.)

TRAILS TO THE BRIDGE

Reference has already been made to the barrenness and roughness of the country. The trails by which the bridge may be reached are so crooked, so steep in places, and so faint that the services of a guide for pack train parties are indispensable (see Fig. 3).

A Navajo Indian living at Kaibito Springs, Ariz., has taken pack trains from that place to the bridge, going northward across the canyon of Navajo Creek and past the west base of Navajo Mountain. The trip requires one and one-half days each way. Kaibito Springs, which is south of the bridge, may be reached by taking an automobile at Flagstaff, Ariz., on the Santa Fe line, and going by way of Tuba and Red Lake, a distance of about 130 miles.

Another route to the bridge for pack train, requiring three days each way, leads from Kayenta, Ariz., southwestward to the head of Marsh Pass, northwestward up Laguna Canyon past its cliff dwellings, across the head of Piute Canyon, and around the east and north sides of Navajo Mountain, a total distance of about 85 miles.[7]

Kayenta may be reached by automobile from Flagstaff, a distance of 155 miles, and from Gallup, N. Mex., also on the Santa Fe line, a distance of 190 miles. Another route is by way of Blanding, which may be reached by automobile stage from Thompson, Utah, or from Dolores, Colo., both on the Denver and Rio Grande Western Railroad, by way of Monticello, Utah.

Routes by the Colorado and San Juan Rivers

In October, 1921, K. W. Trimble, of the United States Geological Survey, with his assistants, mapped Bridge and Aztec canyons and the adjacent portion of the Colorado Canyon, in connection with the mapping of the San Juan and Colorado canyons for a power and reservoir project at Lees Ferry, Ariz.[8]

Bridge Creek heads in the northwestern slope of Navajo Mountain, runs in a northwesterly direction, and enters Aztec Creek one and one-half miles below Rainbow Bridge. Aztec Creek in turn enters Colorado River at a point 3.1 miles farther north. These creeks are perennial, each having a normal flow of a few cubic feet a second, and they afford an abundant supply of good clear drinking water. Aztec Creek is the first perennial stream entering the left side of the Colorado below the mouth of San Juan River, its mouth being 9.6 miles below the San Juan. Trimble reached the bridge and this part of the Colorado Canyon after he had mapped the practically unknown San Juan Canyon from a point near Bluff, Utah, to its mouth, a distance by stream of about 140 miles.

Three or four government parties, including H. D. Miser and Sidney Paige, that descended Colorado River in 1921 also visited the bridge by ascending Aztec and Bridge canyons from the river. Another party in

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[7] See also the route described by C. L. Bernheimer: Encircling Navajo Mountain with a Pack-Train (*Natl. Geogr. Mag.*, Vol. 43, 1923, pp. 197–224), on his expedition of 1922, and E. H. Morris: An Unexplored Area of the Southwest (*Natural History*, Vol. 22, 1922, pp. 499–515), on the expedition of 1921.

[8] Now available in 22 sheets (16 plans, 6 profiles), U. S. Geological Survey.

1921 ascended the Colorado from Lees Ferry in a flat-bottomed boat equipped with a motor-driven paddle wheel at the stern; the upstream trip of 68 miles with this boat required five days. Besides the parties just mentioned only a few others have visited the bridge from the Colorado, though several have made the attempt and failed on account of inability to identify the mouth of Aztec Canyon.

THE PLACE OF THE EASTERN NATIONAL FORESTS IN THE NATIONAL ECONOMY

By W. W. Ashe
National Forest Reservation Commission

While the great bulk of our National Forests lies west of the Mississippi, the 2,000,000 odd acres of the eastern reserves constitute an asset of no small importance to the American people. Essentially economic in supplying timber and protecting stream flow, they are filling a still broader field of usefulness in connection with our recreational program. Their importance in this respect will grow with the diminution of wild forest and with increase in population. The eastern National Forests, though largely lacking in the scenic grandeur to be found in the western reserves, afford a rare opportunity for recreation. With the State Forests, developed and being developed by several of the eastern states, they serve 75,000,000 people. More than 25,000,000 people are within a day's automobile trip of at least one of these forests.

National Forest System

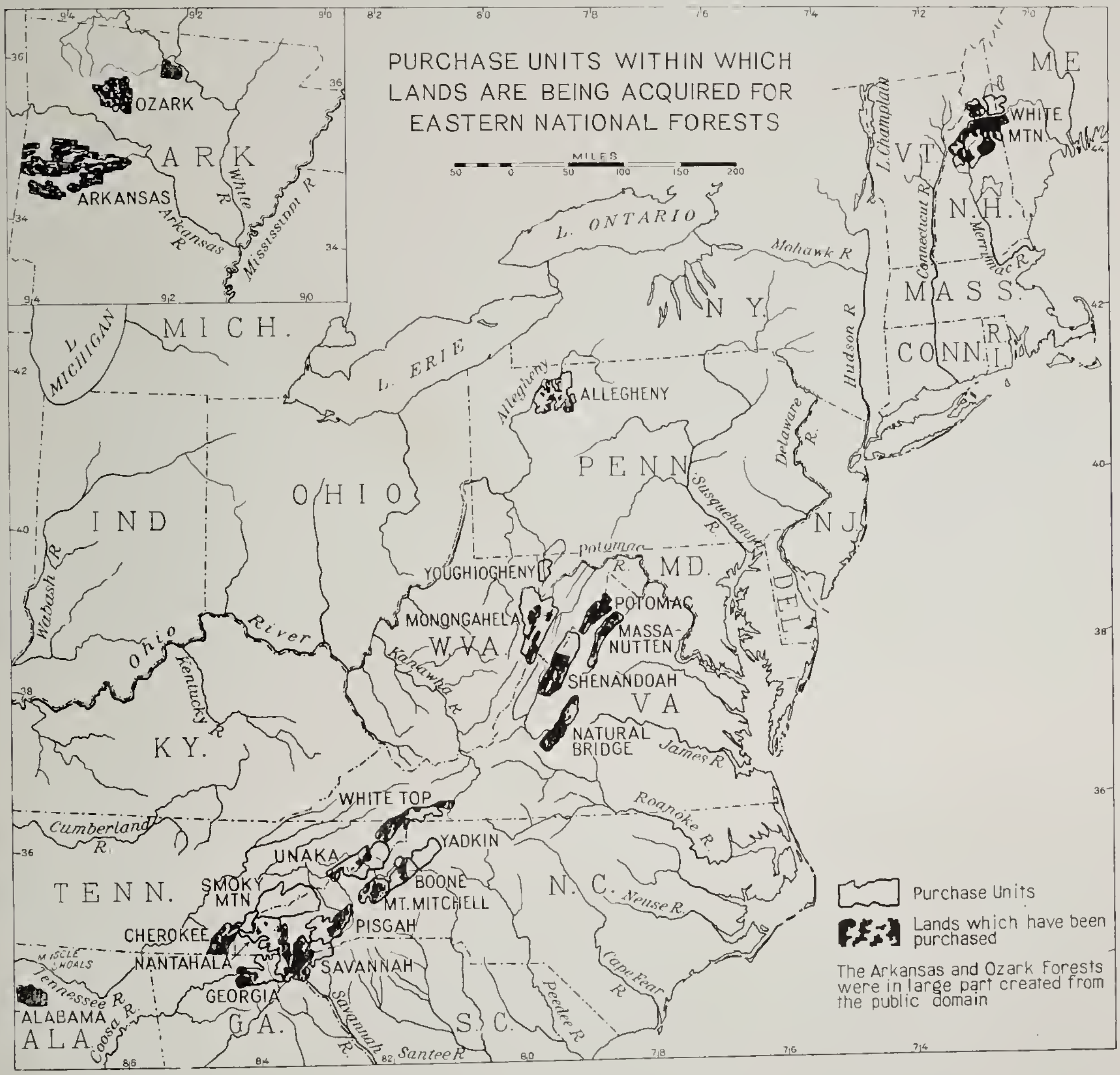
The National Forest system was inaugurated by withdrawal from the public domain of certain lands, largely in the western states, which were not suitable for farming and whose permanent utility it seemed could best be secured by retaining forests thereon. In most of the eastern states there was never any public domain (a fact now often overlooked); although in Florida, Michigan, and Alabama, at least portions of which became public domain, there did remain small areas which, while mostly in scattered holdings, were suitable for National Forest purposes. The eastern Forests are being built up out of lands acquired by purchase from private owners. It is first necessary that the states which desire such purchases to be made within their borders cede to the federal government the right to acquire lands.

The Weeks Law

As early as 1895 there was a movement on foot in New England and in the southern Appalachian states for public ownership of mountain lands; but it was not until March 1, 1911, that authorization was obtained by the passage of the Weeks Law through which the National Forest Reservation Commission came into being.

The act provided for the acquisition of lands located on the waters of navigable streams of such character, in the view of the Geological Survey, that the maintenance of a forest cover thereon would be of value in promoting their navigability. Thus lands available for purchase are largely restricted to such as are situated in a mountainous or very rugged area, or to sites where soil erosion is excessive, or where the soil is of such a character that heavy rainfall is not readily absorbed unless there is a protective blanket of humus.

There was no limitation of purchase to any one section of the country; but, since the area of National Forests in the western states at the time of passage of the act amounted to more than 150,000,000 acres, the Commission has regarded it as especially affording means of securing the benefits of forest protection for the eastern states and has shaped its policy accordingly.



PURCHASE UNITS WITHIN WHICH LANDS ARE BEING ACQUIRED FOR EASTERN NATIONAL FORESTS

The Arkansas and Ozark Forests were in large part created from the public domain

Fig. 1—Map showing the National Forests of the eastern United States. Inset are the Arkansas and Ozark Forests. Scale of map approximately 1:13,000,000.

Two Great Eastern Regions Needing Watershed Protection

When the act was passed there were in the eastern states two general regions where conditions were such that there was urgent need for watershed protection. One of these regions was the White Mountains of Maine and New Hampshire, embracing the highest lands in the northeastern states and the headwaters or principal feeders of four important New England streams. The other was the Appalachian Mountain region southward from New York to Alabama. A large portion of the Adirondack region had already been acquired by the state of New York, and the state of Pennsylvania was acquiring forest lands, particularly in its central and eastern parts.

In New England, owing to more porous soils and smaller precipitation, with much of it in the form of snow, forests have relatively less influence upon stream flow than farther south. Southward the precipitation is heavier (reaching a yearly average of more than 80 inches at Rock House, Macon County, N. C.), and only a small proportion of it is in the form of snow. The rainfall is often of a most concentrated character, as much as 22 inches having fallen within two days (July, 1916, at Altapass and Highlands, N. C.), which is approximately half the average precipitation of New England for an entire year. Southward also the soils are less permeable and more prone to excessive erosion, particularly in the region to the east of the Blue Ridge in Virginia and to the northward and to the east of the Unaka Mountains. On account of these conditions the influence of forest cover upon stream flow is more potent to the south of New York state; an influence which, through reducing erosion, is particularly efficacious in respect to the utilization of streams for power purposes. One of the most noted examples of erosion in the Appalachians is that surrounding the smelters at Ducktown, Tenn. Here for many square miles destruction of the forests and other vegetative cover has resulted in unrestricted erosion. The detritus has largely reduced the storage capacity of reservoirs and has in part moved farther down into the main channel of the Tennessee River, forming silt bars to be removed only by costly dredging.

Water Power Development in the Southern Appalachians

With the recent development of long-distance electric power transmission by means of high-voltage lines it has become possible to make use of water resources situated at great distances from the points of power consumption; and the enhanced prices of steam coal, which have more than doubled during the past ten years, have greatly stimulated the development of water power. A feature of this development has been the construction of reservoirs for the purpose of storing the storm water of flood seasons by the release of which during periods of low water a uniform flowage is secured and thus a more complete use of water. Streams with very erratic flow are thus susceptible of economic exploitation. Such developments are not feasible unless there is assurance of permanency of water storage, and this assurance is absolutely dependent upon the prevention of soil erosion.

Plans for the development of the water resources of the Tallulah and Chattooga Rivers, two of the important head streams of the Savannah River, call for a 95 per cent utilization of the flowage. These plans are already in large part executed on the Tallulah, where three units out of five called for in the plans have been completed while the fourth is in course of construction. The reserviors so far completed impound 8,000,000,000 cubic feet of water, and the plants have a generating capacity of 140,000 kilowatt hours with an average annual output of 534,000,000 kilowatt hours. The total generating capacity will be increased to 175,000 kilowatts, and the storage capacity will be nearly 9,000,000,000 cubic feet upon the completion of the Tallulah River Plan. The Chattooga River will be developed in the same manner. Similar developments also are partially completed on the head streams of the Catawba River, which are protected by the Boone and Mt. Mitchell divisions of the Pisgah National Forest. On the Little Tennessee River, plans have been formulated; and the first unit, developing more than 90,000 horse power, in a system of eleven units has been finished. It is expected that this development when completed will control 90 per cent of the discharge of the Little Tennessee, which is one of the most important tributaries of the Tennessee River. These projects and others in contemplation will make use so far as possible of streams whose basins lie within National Forests, and which are assured of the reduction of erosion to a minimum by the protection afforded by a well maintained forest cover.

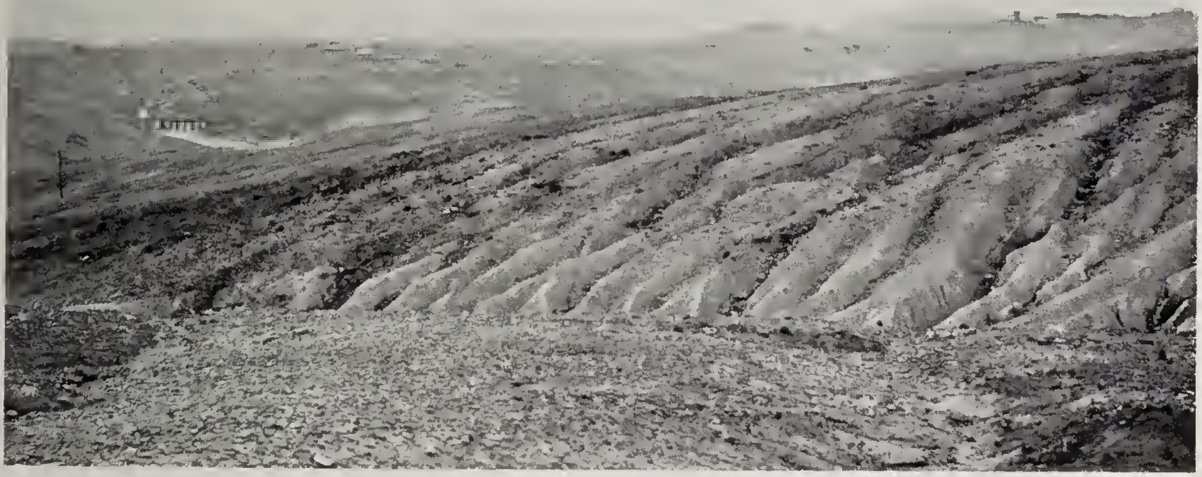


FIG. 2—Unrestricted erosion about the smelters at Ducktown, Tenn., following destruction of the vegetative cover. The detritus has silted up storage reservoirs and formed silt bars in the main channel of the Tennessee River.

THE MUSCLE SHOALS PROJECT

Reference has already been made to the problem of erosion in relation to silting. As a specific instance we may note its bearing on the Muscle Shoals project, wherein large investments have been made by the Government. The report of the engineer on the Tennessee River calls attention to the rapid rate of silt deposit in the slack-water pools above the dams on this river, as well as the enormous fluctuations in the flow. Ultimate development of the half-completed project will depend upon storage of storm water

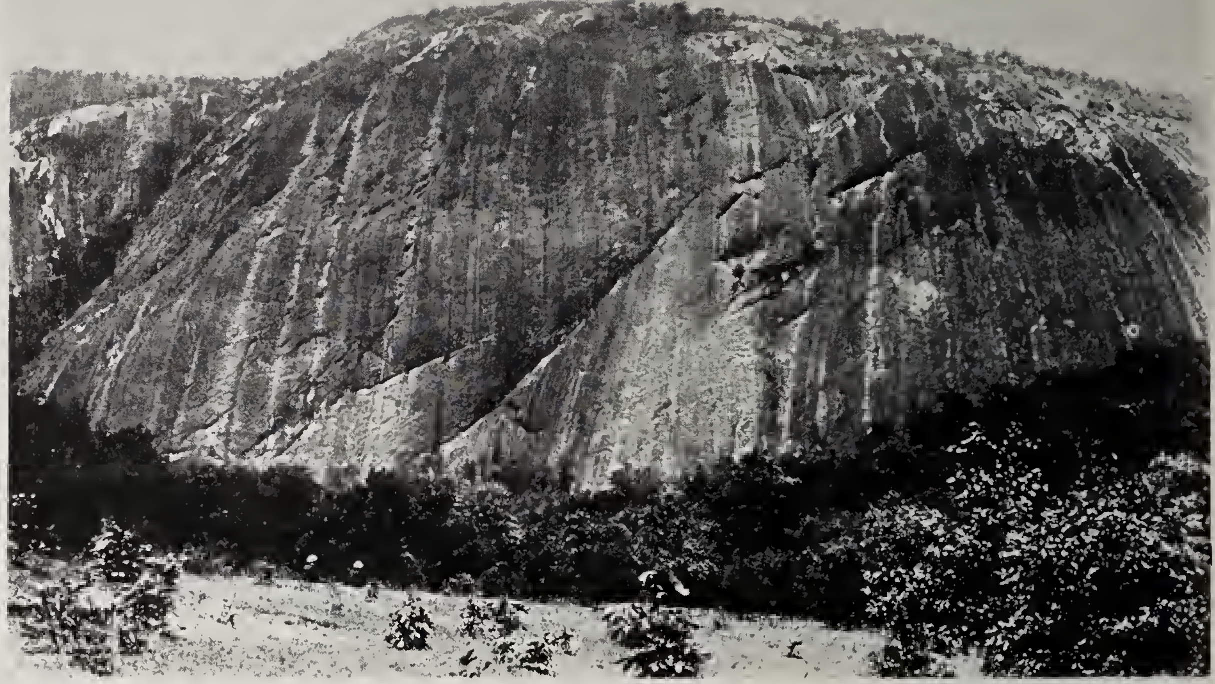


FIG. 3

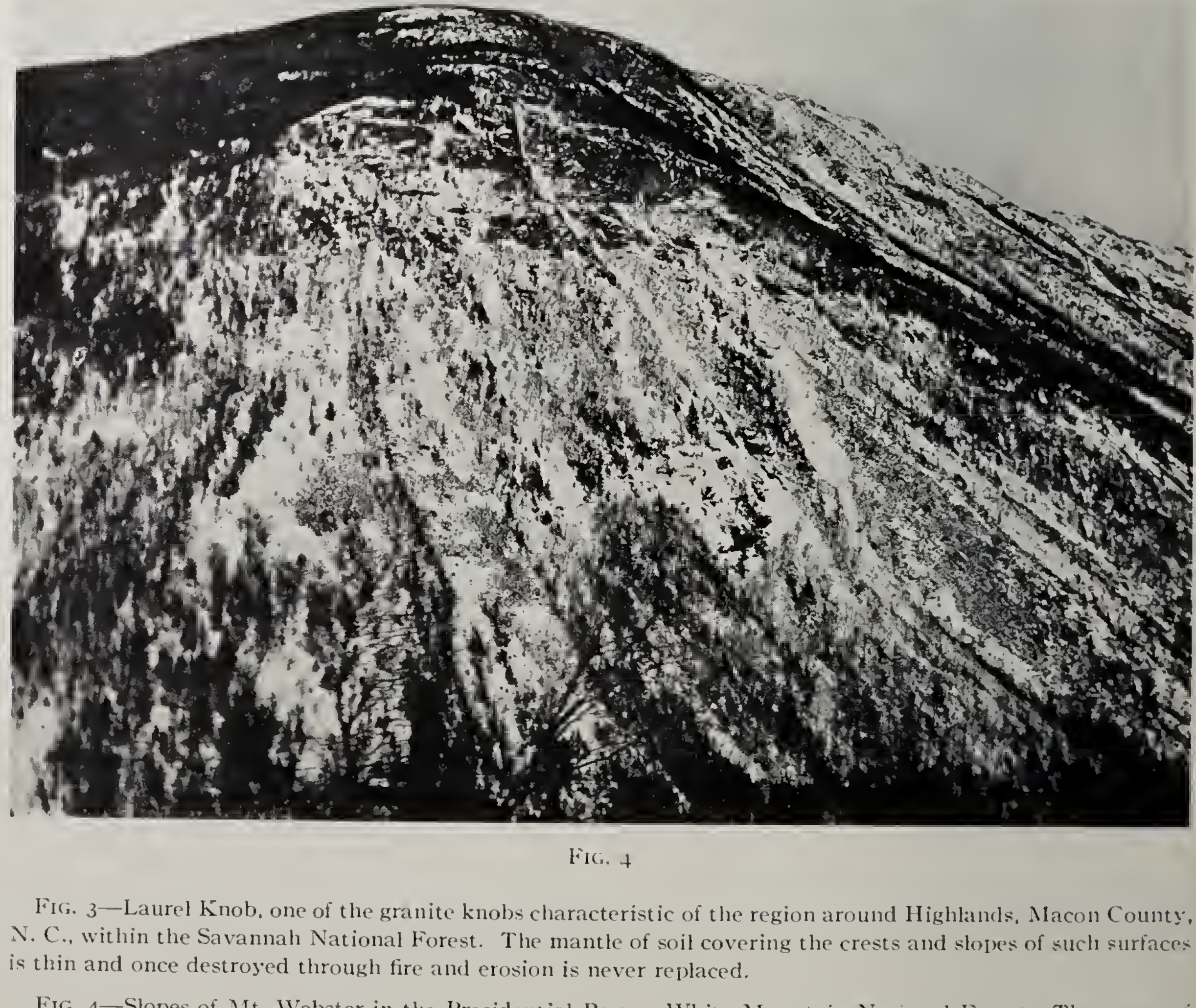


FIG. 4

FIG. 3—Laurel Knob, one of the granite knobs characteristic of the region around Highlands, Macon County, N. C., within the Savannah National Forest. The mantle of soil covering the crests and slopes of such surfaces is thin and once destroyed through fire and erosion is never replaced.

FIG. 4—Slopes of Mt. Webster in the Presidential Range, White Mountain National Forest. The cover of heavy spruce forest was destroyed by fire about 150 years ago, and the spruce has not succeeded in re-establishing itself except in small patches.

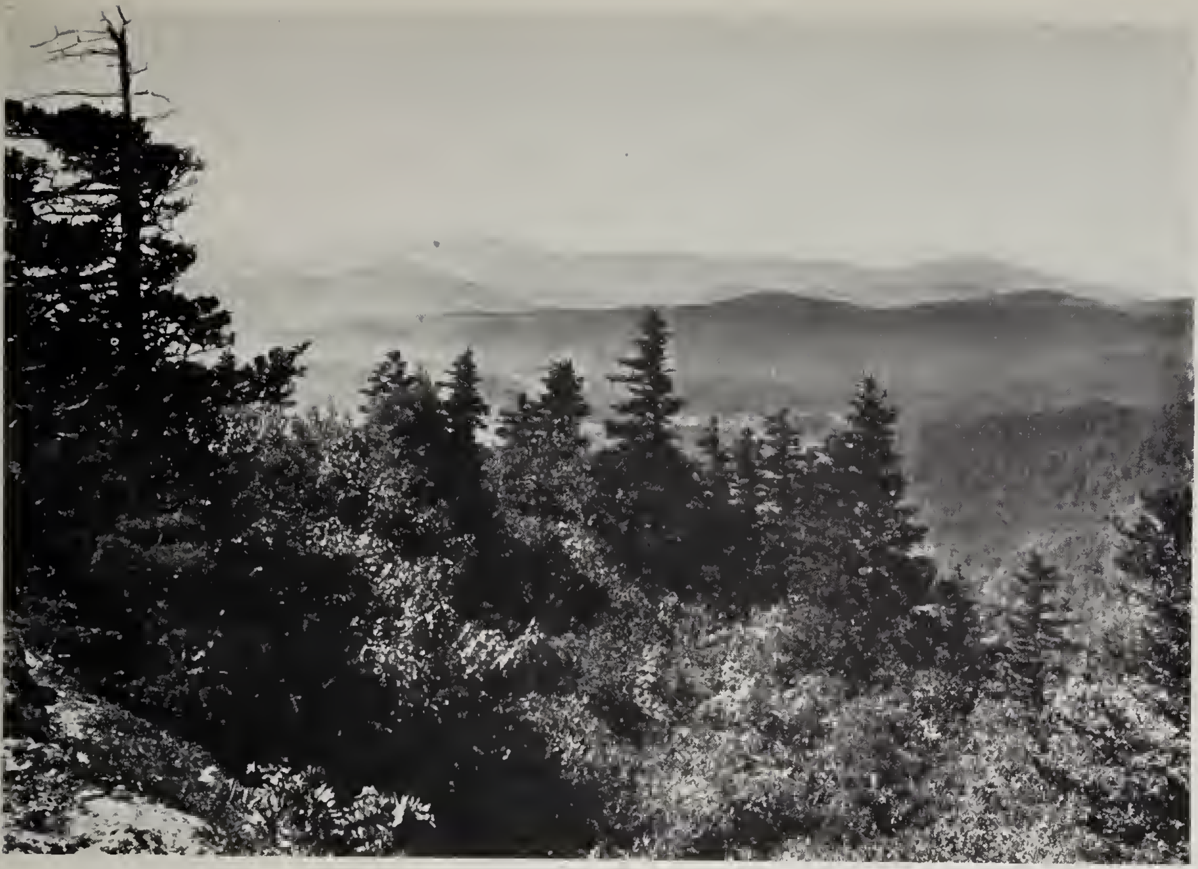


Fig. 5

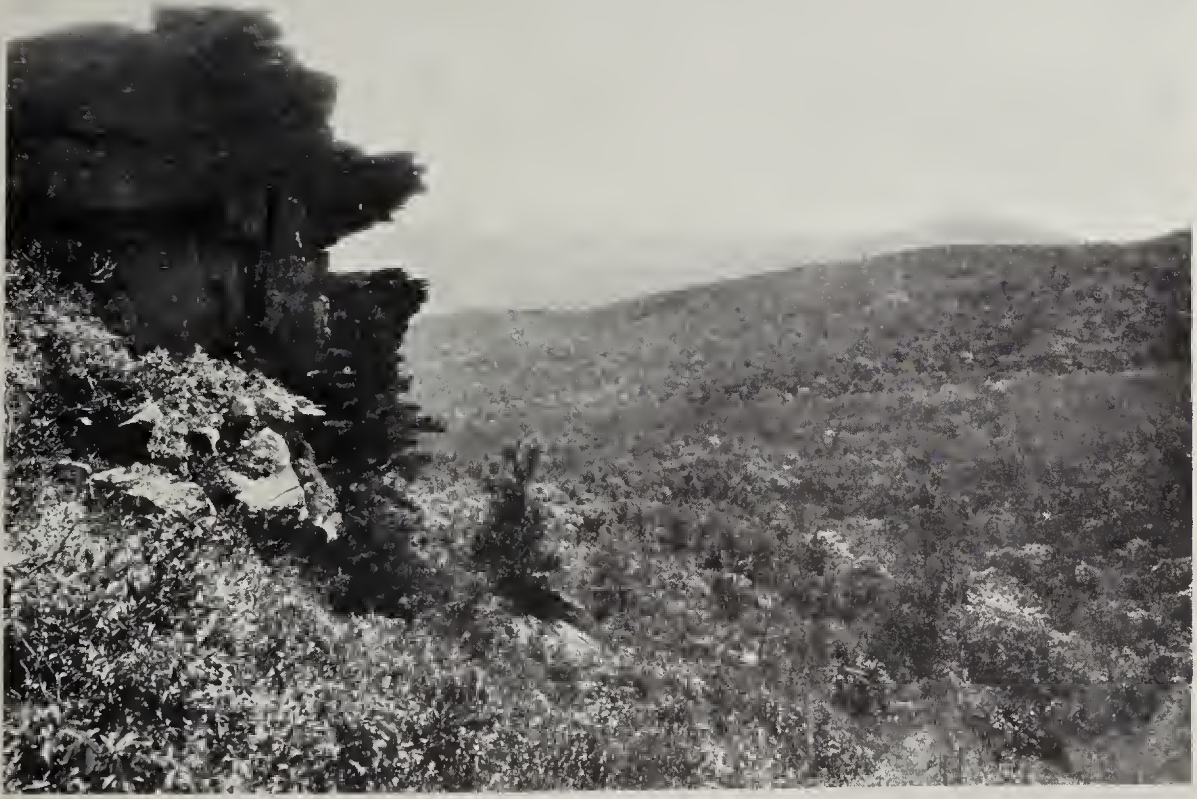


Fig. 6

Figs. 5 and 6—Characteristic scenery in the National Forests of North Carolina. Figure 5 is looking across the valleys of the Linville (Catawba basin) and Toe (Tennessee basin) Rivers with the Big, Yellow, and Roane Mountains on the sky line. Figure 6 shows the upper valley of the Johns River, tributary of the Catawba, with Table Rock, Hawksbill, and Grandfather Mountains on the sky line.

on the head streams of the Holston, Estetoe, French Broad, and Little Tennessee Rivers, which are the important mountain tributaries of the Tennessee River. Conditions on these streams are practically repeated on every large stream in the Southeast.

Nor are such cases to be considered as local problems. Only recently electric power generated by these mountain-fed streams was transmitted by interchange more than 500 miles to supply deficiencies in power resulting from drought; and we may well look forward to power generated, let us say, in Virginia being utilized in New England and to power from the much discussed Muscle Shoals being used in Detroit and Chicago.

United States Lumber Conditions in General

A review of the forest conditions throughout the entire United States and their relation to purchases under the Weeks Law is interesting. The production of lumber in the United States reached its maximum, with a cut in excess of 40 billion board feet, in 1907. This was the date of the maximum cut of lumber in the northeastern states, followed two years later by the maximum in the southeastern states, while about the same time began the shifting of production from the Atlantic to the northwestern Pacific states. The Atlantic states were no longer able fully to meet the demand of the northeast, the region of largest consumption, and the marginal production was supplied by the Pacific coast. This was accompanied by a sufficient advance in the price of lumber to permit shipments from that section. As the timber cut of the East continues to decline, a larger proportion of its needs is being supplied by the West; and this will continue until the privately owned Western lands also have been cut over and have largely ceased to be productive. The future needs of the West will be supplied in part at least by the extensive National Forests located beyond the Mississippi River; the East must largely depend upon the increment from privately owned lands, amounting to 300,000,000 acres, whose owners are directed and encouraged through federal and state co-operation and incentive.

More than 4,000,000,000 board feet of timber have been acquired in connection with the 2,211,742 acres within the eastern National Forests. The acquired lands are capable of producing not less than 300,000,000 feet of timber each year. This, however, is practically of minor significance in the problem of supplying timber for the East, which will require the full production of its entire forest area to meet its own economic needs of about 25,000,000,000 feet a year. Acute timber shortage, not only in the East but also in the West, will materialize, unless our cut-over forest lands can be put on a producing basis, within two decades, at which time our industries will be practically dependent upon the yield of the second-growth forests on cut-over lands. The area of this class of lands, now amounting to more than 200,000,000 acres, or about five times the total area of the state of Missouri, is increasing each year; an enormous amount of it has been burned over and devastated, and its earning value temporarily destroyed or seriously impaired. The policy of purchase has been not to acquire a large amount of mature timber. Little would be gained by the mere withholding of merchantable timber from market. The ideal lands for carrying out the purposes of the law are such as have been culled and partly cut over, unburned, and on which there is a natural setting of young timber. Such lands under management will be ready for cutting about the time when the shortage takes place in west coast timber. The situation is summed up thus:

> Of this enormous amount [of cut-over land, more than 200 million acres] and excluding the National Forests created from public domain, only about ten million acres of land are being adequately protected and managed by public and private interests. The industrial needs of the country require that this entire area again be made productive. . . . Without minimizing in any way the actual contribution which the eastern National Forests will make to the timber supply of the eastern states, it is believed that one of their greatest contributions in this direction will be made indirectly through stimulating private owners and the states in which such lands are situated in developing and applying methods of management to forest lands which have been cut over. For this reason it is desirable that the eastern National Forests be distributed as widely as possible and, conformable to the requirements of the law, should be located in those sections where there seems to be the greatest possibility of securing the emulation of private owners.[1]

At the present time purchases are confined to eleven states (see Fig. 1). The report enumerates thirteen additional eastern states in which there are cut-over lands of a character demanding protection in accordance with the principles of the act under which the eastern Forests have been established, but to which it has not yet been possible to extend purchases.

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[1] Ann. Rept. of the National Forest Reservation Commission for the Year Ending June 30, 1922, *Senate Doc. No. 273, 67th Congr., 4th Sess.*, pp. 29–30.

ORIGIN OF THE COPPER ESKIMOS AND THEIR COPPER CULTURE *

By Diamond Jenness
Geological Survey of Canada

There is a peculiar attraction about a people which is in the transition stage between the stone and the iron ages.[1] In such a people we seem to be studying not so much the development of an outward civilization as the mental processes of man before the dawn of history. For this reason, as well as for the intrinsic beauty of its relics, the bronze age of Europe has always attracted a host of enthusiastic investigators. America, too, has had its transitional period, in some places a true metal age marked by the smelting of copper and of tin, in others only a pseudo-metal period, copper being treated simply as a malleable stone. The Eskimos inhabiting the regions around Coronation Gulf were in this pseudo-metal stage. Pure native copper is found there in three places; at the head of Prince Albert Sound on Victoria Island, in the Copper Mountains west of the Coppermine River near its mouth, and on the islands in Bathurst Inlet. Copper obtained from all these sources was hammered into tools and weapons by the Eskimos, but most of their supply seems to have come from the Copper Mountains. Among the Eskimos of northern Greenland there was also a pseudo-metal period marked by the use of meteoric (and possibly telluric) iron instead of copper; but this use of iron never extended outside of Greenland and so does not come within the scope of this paper, which is concerned only with the Central Eskimos and their copper.

The Ancient Population in Coronation Gulf

The earliest evidence of inhabitants in the present home of the Copper Eskimos, the region around Coronation Gulf, comes from archeological sources. At various places along the coast there have been found graves in the shape of stone cairns and ruins of houses built of wood and covered over with sod. The Copper Eskimos of the present day, like their kinsmen in Hudson Bay, do not cover their dead, but merely leave them on the surface of the ground to the mercy of the elements and beasts of prey; but stone cairns of a similar character to those of Coronation Gulf were discovered by Mr. Stefansson on the fringe of the Mackenzie region around Cape Parry and Langton Bay. Houses of wood covered over with sod are also unknown to

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* Published by permission of the director, Victoria Memorial Museum, Ottawa.

[1] By stone, copper, bronze, or iron age throughout this paper I mean the period during which stone, copper, bronze, or iron predominated in all implements that require an edge, as knives, harpoon points, arrowheads, etc.

the present inhabitants of Coronation Gulf, although in the Mackenzie delta and in Alaska they constituted the normal type of dwelling. Excavation of the ruins revealed the presence of pottery, likewise a western, not an eastern Eskimo product, together with harpoon points and fishhooks that were foreign to the Copper Eskimo culture but quite usual in the Mackenzie delta and in Alaska. We can have no hesitation therefore in ascribing these ancient ruins in the Copper Eskimo country to a tribe or tribes affiliated with the Eskimos dwelling today in the Mackenzie delta.

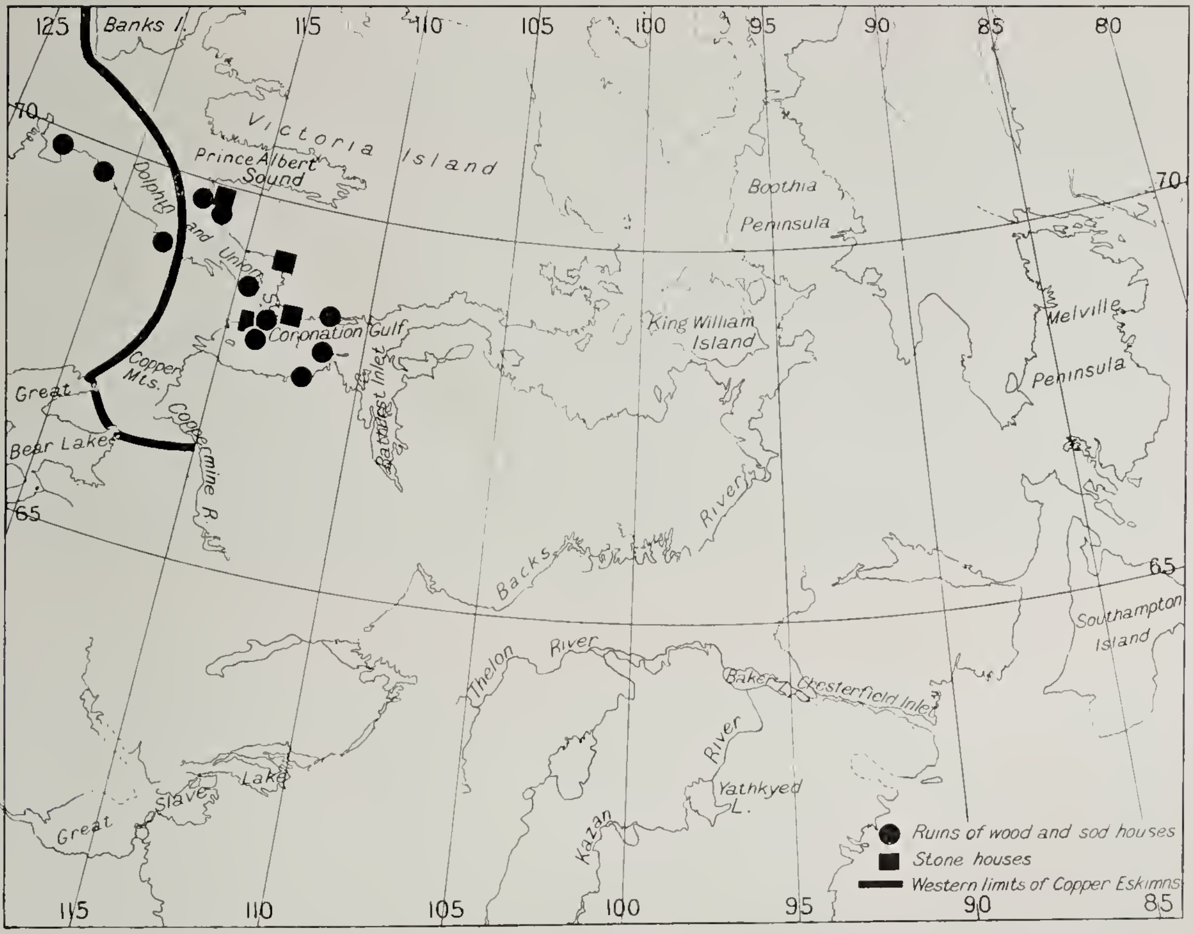

FIG. 1—Map showing the western limits of the Copper Eskimos and the distribution of Eskimo house types in the vicinity of Coronation Gulf.

Furthermore, we may be reasonably sure that they actually migrated from the west, for otherwise they would not have used driftwood for their dwellings, driftwood being very scarce in Coronation Gulf.

The date of the ruins can only be conjectured. In one settlement the floors of the houses are said to have been three or four feet below the general level of the terrain, but the turf that covered the walls and roofs would probably account for about two feet of this depth. No precise estimate can be made of the time required for an extra foot or two of soil to accumulate above this, since that would depend on the nature of the vegetation, the position of the ruins, and the watershed of the surrounding country. Judging, however, from similar remains on the north coast of Alaska we should

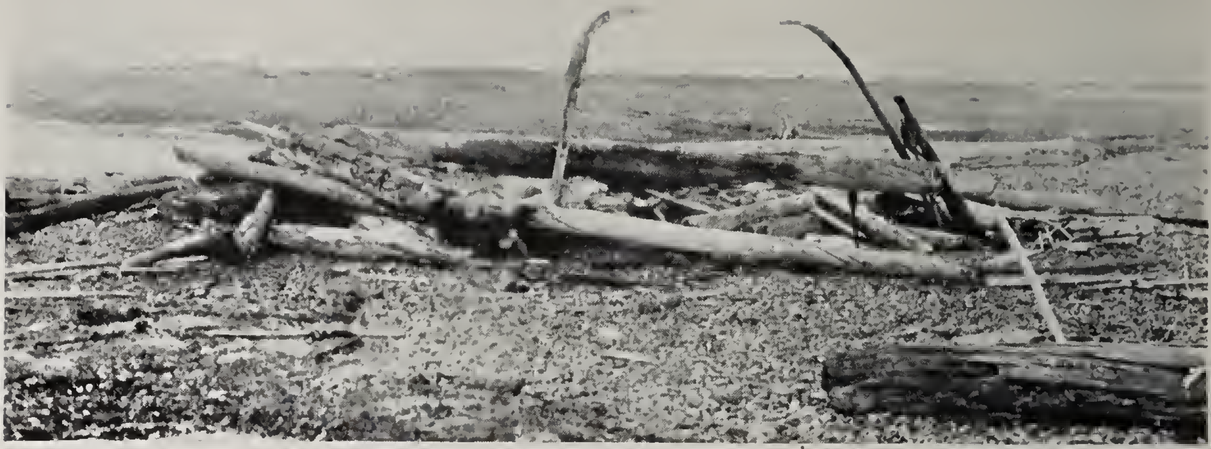

FIG. 2

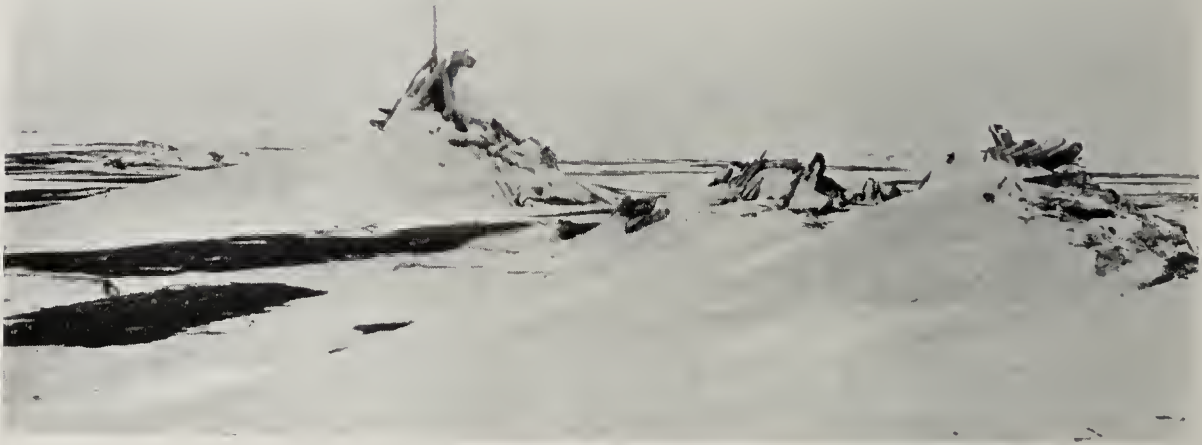

FIG. 3

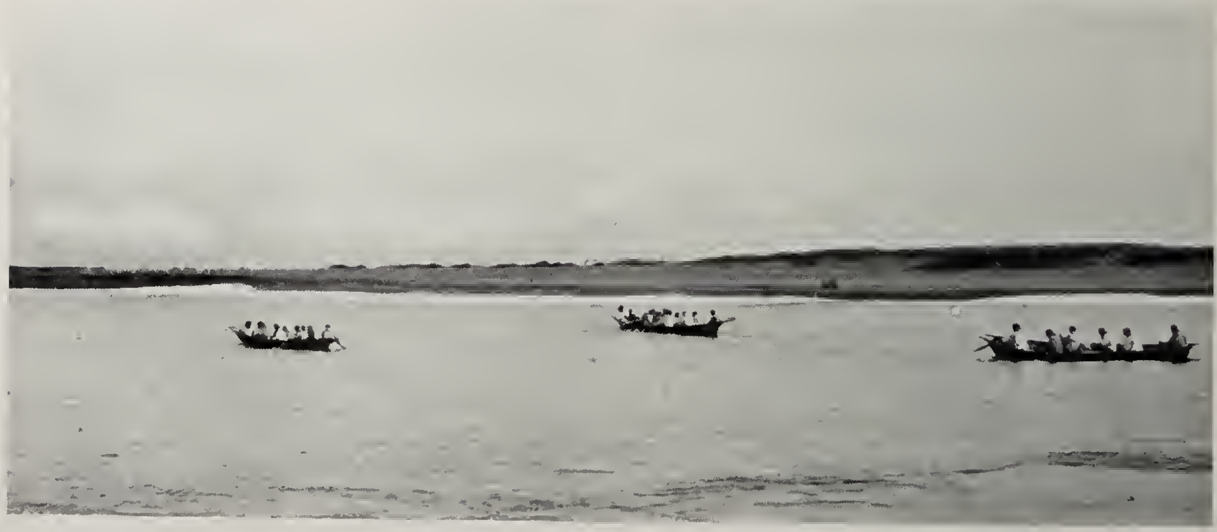

FIG. 4

FIGS. 2-4—Cultural features of the western Eskimos.

FIG. 2—Grave of a western Eskimo, covered with logs in the usual manner. Barter Island, northern Alaska. (Photograph by D. Jenness.)

FIG. 3—Ruins of wood and sod houses at Demarcation Point, on the Alaska-Canada boundary, once inhabited by Mackenzie River Eskimos. (Photograph by D. Jenness.)

FIG. 4—The umiak, or large skin boat, of the western Eskimos. (Photograph by D. Jenness.)

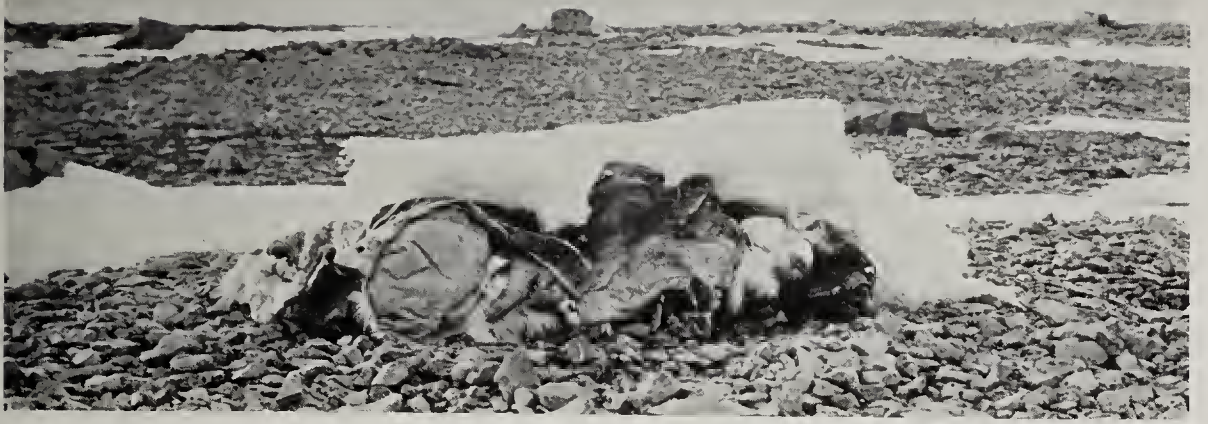

FIG. 5

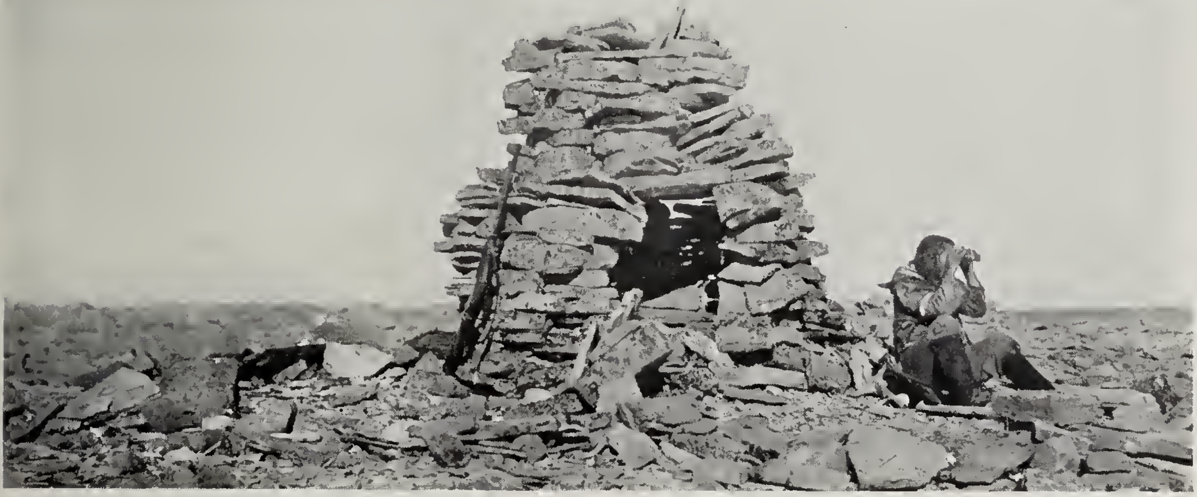

FIG. 6

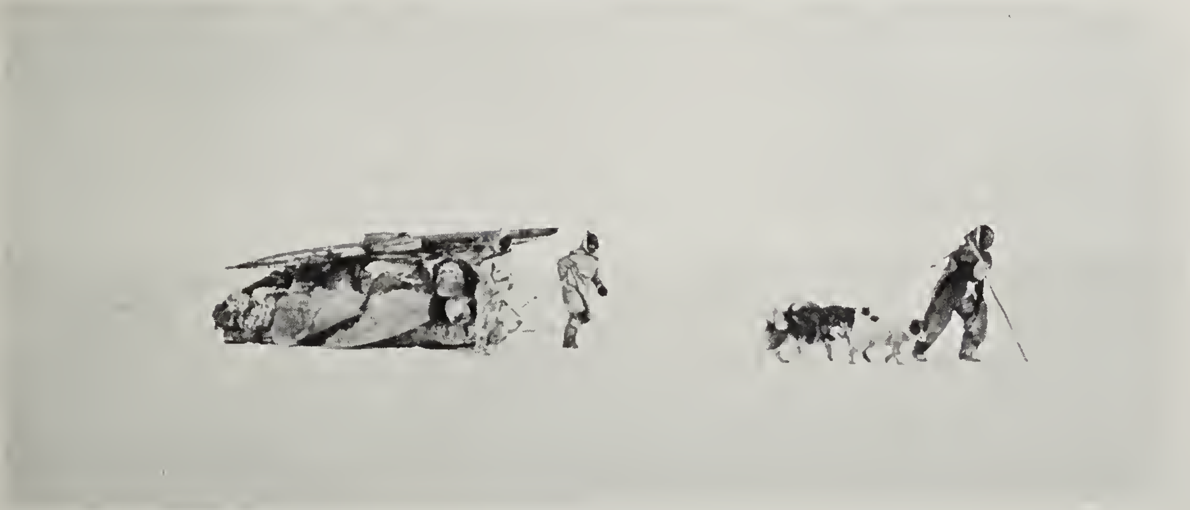

FIG. 7

FIGS. 5-7—Eskimo cultural features of eastern origin.

FIG. 5—Grave of a Copper Eskimo. The body lies unprotected on the surface of the ground. (Photograph by G. H. Wilkins.)

FIG. 6—Ancient stone hut at Cape Krusenstern, Coronation Gulf, indicating presence of eastern Eskimos. (Photograph by D. Jenness.)

FIG. 7—Migration of a Copper Eskimo family, with a long river kayak on the sled. (Photograph by R. M. Anderson.)

hardly be justified in assigning an age of more than five or six hundred years to the ruins in the Coronation Gulf area.

Besides the undoubtedly western character of these ruins one very significant point must also be noticed. As far as my information goes at present no copper was found within them. Very little copper, if any, has been discovered in similar ruins in the Mackenzie delta and in Alaska. Hence we may reasonably conclude that the use of copper was practically unknown to the Eskimos at this period, at least from Coronation Gulf westwards. The Eskimos of Hudson Bay may have been acquainted with copper through contact with Indian tribes, but there also its absence in archeological remains proves that any such acquaintance must have been very slight and almost negligible.

At Cape Kellett, on Banks Island, there was an ancient settlement where whalebones were used instead of wood for the framework of the houses.[2] It was evidently an important center for whale hunting, like Cape Bathurst on the mainland opposite. Many whalebones were found also around some of the old wood and sod houses in the Coronation Gulf area, and their inhabitants must have been familiar with the methods of hunting whales. Probably, therefore, they possessed the large open skin boats called umiaks which were usually employed for whaling. The present inhabitants of Coronation Gulf and for some distance east along the coast did not use these boats in historical times, nor is there any evidence to show that they had used them at an earlier period. It is true that they knew of them traditionally, but such traditions may easily have filtered in through trade with either the eastern or the western natives.

The first questions that arise in connection with these ancient settlements are, why did they fall into decay, and what became of their inhabitants? The Eskimos as a race have short memories, and their traditions never carry us very far back into the mists of the past. Consequently the actual historical reasons can never be discovered, although we may conjecture some of the causes. In the first place the whaling pursuit could never have been very successful in Dolphin and Union Strait and Coronation Gulf, since whales rarely enter these restricted waters. Then, again, wood for the building of houses and of large skin boats is very scarce along the coast. Consequently the old population would soon be forced either to change its western culture or to move elsewhere. A few lean years may have reduced its number, never very great, and forced the survivors either to return west to their earlier home or to push farther eastward, there to be swallowed up in other tribes where the mode of life was different. The few who remained behind in the region around Coronation Gulf must later have merged with the immigrant people who form its present population.

Theoretically one other possibility is open with regard to the fate of these ancient inhabitants. It may be conceived that they slowly altered their mode of life and became the ancestors of the Copper Eskimos of the present day. If this were the case we should expect the modern culture in this region to retain its western character with only such changes as were forced upon it by the environment and by the more or less sporadic intercourse with eastern Eskimos. In this way we might explain perhaps the cessation of whale hunting and the loss of the umiak, together with the change from wood and sod houses to snow huts. Copper, if altogether unknown, may have supplanted stone through some brilliant discovery or through a knowledge gained from the Yellow-knife Indians to the southward. But will this theory explain in detail the culture of the Copper Eskimos as it is known today? And can we reasonably interpret this culture as developing out of the stage represented by the old whale-hunting people and their kinsmen to the westward?

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[2] See "The Life of the Copper Eskimos," *Rept. of the Canadian Arctic Expedition 1913–18*, Vol. 12, p. 46.

PRESENT DAY COPPER ESKIMOS IMMIGRANTS FROM EAST

An examination of the culture of the Copper Eskimos of today reveals one fact very clearly: their nearest affiliations are not with the Eskimos of the west but with those of the east and southeast. In material culture they so closely resemble the Netchilik Eskimos of King William Land and Boothia Peninsula that both must have the same historical background. Both groups, for example, use the same types of weapons for sealing, fishing, and caribou hunting; their household utensils have the same forms; and their dwellings, both snow huts and skin tents, are of the same shape and internal arrangement. Such differences as appear in the sled gear and in costume are of a minor character only, while the art patterns and the tattooing are the same in both places.

Customs, traditions, and religious beliefs also link the Copper Eskimos with eastern tribes rather than with western. The natives of the Coronation Gulf area frequently visited the Netchilik Eskimos and the Eskimos on the Thelon River; they knew of tribes as far east as Admiralty Inlet on Baffin Island and as far south as the Kazan River that runs north towards Chesterfield Inlet. Their geographical knowledge of the country to the west, on the other hand, was much more limited. Their travels in that direction rarely extended beyond Wise Point, which is barely outside the limits of their normal range; and only one name, Uwallinirmiut, was known for the western natives and for whatever subdivisions there might be among them. The mythology of the Copper Eskimos most closely resembles the mythology recorded from Hudson Bay. Both places have the well-known Sedna myth,[3] which has not been found in the Mackenzie delta or in Alaska; moreover, the personal taboos so common in the two latter places are unknown in Coronation Gulf and eastward, where much more emphasis is laid on the distinction between sea products and land products. We may cite also the evidence of burial customs. In Coronation Gulf, as in the east, the dead are simply laid out on the surface of the ground, unprotected, but with replicas of their clothing and miniature implements placed beside them; in the west no such miniature articles have been found in the graves, which were always covered with stones or logs of wood.

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[3] See Franz Boas: The Eskimo of Baffin Land and Hudson Bay, *Bull. Amer. Museum of Nat. Hist.*, Vol. 15, 1907, pp. 1–570; reference on pp. 163–165.

Finally the linguistic evidence definitely links the Coronation Gulf area with a central group that includes northeastern Hudson Bay from the Kazan River in the south to the Netchilik Eskimos of Boothia Peninsula. Some of the specific marks of the dialects in this region, as distinguished from the dialect of the Mackenzie delta area, are:

1. The use of *n* and *ng* instead of *t* in many terminations.
2. A preference for the *poq* and *voq* conjugation endings, whereas these are generally replaced in the Mackenzie area by *toq* and *yoq*.
3. The spirantizing of *s* to *ch* (of German *ich*), with a tendency for it to become a pure breathing in initial positions.
4. The appearance of voiceless *l* (this is less certain).
5. Frequent substitution of conjunctive mood for indicative.

Language, traditions, and customs, then, all point to the Copper Eskimos being merely a subgroup of the Eskimos of Hudson Bay. They must therefore be comparatively recent immigrants into the Coronation Gulf region, not descendants of the old whale-hunting population that has left its remains along the coast; for it would be highly unreasonable to suppose that this old population in the course of three or four centuries cast off all the most distinctive features of its culture and took on those of the eastern natives; for example that it not only dropped whale hunting in umiaks and seal hunting in kayaks, abandoned the building of wood and sod huts, and lost the art of making pottery, but also changed its style of tent and altered the kayak from the short, rather broad, sea-going type such as persists today in the Mackenzie region to the long, narrow river type that is characteristic of the Netchilik Eskimos and the tribes inland from Hudson Bay. It is not improbable that some of the old inhabitants survived and blended with the immigrants, but the predominantly eastern character of the modern culture in this area shows conclusively that their influence must have been very slight.

Archeology also provides clear evidence of a movement from the eastward into Coronation Gulf. Houses built of stone have never been found among the western Eskimos, although they are numerous throughout the whole of the eastern region from Labrador north to the Parry Archipelago and are still used as dwellings by the Eskimos of Smith Sound in Greenland. Three such houses have already been reported from the Copper Eskimo country, all in the southwestern portion of Victoria Island. Near Cape Krusenstern on the mainland opposite, I myself examined a stone structure which was a little too small indeed for a dwelling but may have been either a meat cache, like the stone piles on Southampton Island in Hudson Bay, or more probably still a fox trap, for which purpose similar structures are erected even today five hundred miles to the eastward on Adelaide Peninsula. This ruin near Cape Krusenstern showed no signs of great antiquity and was certainly much more recent than the wood and sod houses that were discovered later in its vicinity. With the three stone huts on Victoria Island it definitely indicates the settlement of eastern Eskimos in the Coronation Gulf region at a period that cannot date back more than four or five centuries.

ORIGIN OF THE COPPER CULTURE

Now that we have reached the conclusion that the present Copper Eskimos represent, for the most part at least, an immigrant people from the eastward, a second problem comes up for our consideration. Copper was extensively used in this northern area both by Indians and Eskimos. Did each group acquire its knowledge independently; or did one of them, and which one, learn the use of copper from the other?

Let us examine first the evidence from Eskimo sources. A full copper culture—a culture, that is, where copper replaces stone in all the cutting implements—appears only in the region around Coronation Gulf, where there are large deposits of free native copper. The metal was well known to the Eskimos on the shores of Hudson Bay during the last two to three centuries, but from their own statements it is clear that they obtained their supply from Coronation Gulf. Copper has not been found to my knowledge in the older ruins of northern Alaska and the Mackenzie delta. A little drifted in at a later date; but this, like the soapstone lamps and pots, was derived from trade with the Copper Eskimos. At first sight, therefore, it would appear that the only knowledge of copper the Eskimos possessed came from the deposits in the Coronation Gulf area. Now the old wood and sod houses in this region, which are probably not more than five or six hundred years old, reveal a stone-age culture; copper either does not appear at all or is found in very sparing quantities. Consequently the copper culture among the Eskimos must be of comparatively recent growth, so recent indeed that it did not have time to spread far from its home before Europeans appeared on the scene.

We can glean a little more information on the subject from the journal of Samuel Hearne, who made a journey to the mouth of the Coppermine River with a band of Chipewyan Indians in 1771. At Bloody Fall, near the mouth of the Coppermine, his Indians murdered five Eskimo families. Hearne's description of the tools and weapons these Eskimos possessed shows that, with one exception, they did not differ from those in use up to the beginning of the present century. This one exception, however, is all-important. He says: "Their arrows are either shod with a triangular piece of black stone, like slate, or a piece of copper; but most commonly the former."[4] Now a century later the use of slate for arrowheads, or for any tools or weapons, had virtually ceased. No mention is made of it by the explorers of the nineteenth century, although they frequently mention copper arrowheads. One arrowhead tipped with stone (slate?) was obtained by Mr. Stefansson in 1911—the only one, I believe, that has been reported since the days of Hearne. Slate points are still found occasionally on the surface of the ground, but the use of them in 1914 was traditional only, and the method of manufacture was not clearly remembered. It would seem therefore that the Copper Eskimos had passed out of the stone age not so very long before Hearne's day, since they still retained the use of slate in at least one of their weapons, and that a very important one.

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[4] Samuel Hearne: A Journey from Prince of Wales's Fort in Hudson's Bay to the Northern Ocean in the Years 1769, 1770, 1771, and 1772, new edit., edited by J. B. Tyrrell, The Champlain Society, Toronto, 1911, p. 189.

The linguistic evidence might seem to run counter to this conclusion. The Eskimos have almost exactly the same word for copper from Greenland to northern Alaska, and even in northeastern Asia. In Greenland it is *kangnusak*, *kangusak*, or *kannussaq* (according to dialect); from Labrador to northern Alaska it is *kannuyaq;* and in northeastern Asia it is given as *kaniuyak*. There are some obscure features about this word which I do not understand, but the changes that it has undergone in Greenland would indicate that it was present in the eastern dialects before the great Eskimo migrations to Greenland between the eleventh and the fourteenth centuries. But the fact of the Eskimos having a word for copper before 1000 A. D. would not signify a copper culture or that they knew of copper deposits and the art of hammering out the metal. It cannot therefore vitiate the argument that a real knowledge of copper was acquired by the Eskimos only four or five hundred years ago, when it arose in the region around Coronation Gulf.

The Use of Copper Among the Northern Indians

Let us turn now to the evidence on the Indian side. We know that a knowledge of copper was widespread among the Indians in very early times. The deposits around Lake Superior, for example, were worked before the Europeans settled in America. In the north the Yellow-knife Indians of Great Bear and Great Slave Lakes received their name from the extensive use they made of this metal, and from Hearne's testimony we gather that it was not a recent acquisition among them. I may quote his words *in extenso:*

"Before Churchill River was settled by the Hudson's Bay Company, which was not more than fifty years previous to this journey being undertaken [i. e. after 1721] the Northern Indians [Chipewyans] had no other metal but copper among them, except a small quantity of iron-work, which a party of them who visited York Fort about the year one thousand seven hundred and thirteen, or one thousand seven hundred and fourteen, purchased; and a few pieces of old iron found at Churchill River, which had undoubtedly been left there by Captain Monk. This being the case, numbers of them from all quarters used every Summer to resort to these hills [the Copper Mountains near the Coppermine River] in search of copper; of which they made hatchets, ice-chissels, bayonets, knives, awls, arrowheads, &c. The many paths that had been beaten by the Indians on these occasions, and which are yet, in many places, very perfect, especially on the dry ridges and hills, is surprising; in the vallies and marshy grounds, however, they are mostly grown over with herbage, so as not to be discerned.

"The Copper Indians [Yellow-knives] set a great value on their native metal even to this day; and prefer it to iron, for almost every use except that of a hatchet, a knife, and an awl: for these three necessary implements, copper makes but a very poor substitute. When they exchange copper for iron-work with our trading Northern Indians, which is but seldom, the standard is an ice-chissel of copper for an ice-chissel of iron. . . ."[5]

We should not take too seriously Hearne's remarks about the tracks worn by the Indians on their visits to the Copper Mountains. Probably they were nothing but the trails of caribou or musk oxen, which often travel along well-defined paths. But his statement does prove that the northern Indians, including the Yellow-knives, Dog-ribs, and Chipewyans, had a full-fledged copper culture in the seventeenth century, when the Eskimos to the north of them seem not to have fully emerged from the stone age. Moreover, from numerous passages in his journal it is clear that the two races frequently came into contact with each other at this period, and even though such contact may always have meant hostilities, this would not prevent a knowledge of copper from passing from one to the other. We learn also that, although the lower reaches of the Coppermine River were very remote from the usual hunting grounds of the Chipewyan Indians who visited Fort Churchill, so well known was the route that these Indians did not hesitate to make the long and arduous journey of nearly a thousand miles in order to obtain their own supply of copper from the "mines," rather than to rely on their trade with the Yellow-knives. Hearne gives the Chipewyan legend concerning the discovery of these mines, and a slightly different version of the same legend was obtained fifty years later by Sir John Franklin. Although too long to quote here in full, it has an important bearing on our inquiry inasmuch as it ascribes the discovery of these copper deposits near the Coppermine River not to an outside people but to the Chipewyans themselves and implies that they were acquainted with the metal even before this discovery. We cannot tell how long it would take for such a myth to arise, but it certainly does not favor any recent introduction of copper from an outside source.

Eskimo Copper Culture Derived from Indians

Our investigation has now brought to light two facts. First, the limited distribution of copper among the Eskimos, its absence or scarcity in the older settlements, and the use of stone for arrowheads in Coronation Gulf, the center of the Eskimo copper culture, down to the end of the eighteenth century, all indicate that the extensive use of copper among the Eskimos does not date back more than four or five centuries. Secondly, the widespread copper culture of the northern Indians in the seventeenth century was many generations old even at that period; moreover, the Indians throughout a great part of North America were making extensive use of copper long before the arrival of Europeans. In the light of all these facts only one conclusion seems possible: the Indians were the first to learn the use of copper, and the Eskimos borrowed it from the Indians.

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[5] Hearne, *op. cit.*, pp. 197–198.

Migration of the Copper Eskimos Part of a Greater Migration from Inland

I have tried to prove that the Copper Eskimos came about five centuries ago from the east to Coronation Gulf and in that region, through contact with the Indians, acquired the copper culture which marks them off from other Eskimos. Can we gather any clues as to their earlier history?

The subject requires more investigation than I have yet been able to bestow on it. But I have already pointed out a few of the many features that tend to unify all the Eskimo tribes from the Kazan River northward to Boothia Peninsula and Coronation Gulf. The southern tribes, those on the Kazan, Thelon, and Backs Rivers, are inland dwellers, living on fish and caribou and musk oxen. They seldom visit the coast except for trade and, if they know any methods of sealing at all, know only the *maupok* and *utok* methods, i.e. the watching over the seal hole in the ice and the stealthy creeping upon a seal that lies on the surface of the ice outside its hole. Even the Eskimo tribes along the north coast from Dolphin and Union Strait to Boothia Peninsula, who spend more than half the year either on the seashore or on the ice near by, hunting the seals at their breathing holes, are not really a littoral people in the sense that the Eskimos east and west of them are littoral. For the sea is useful to them only when it is frozen solid like the land. Open water, a blessing to the littoral Eskimos, is a hindrance to these northern tribes, since they possess no large skin boats and sealing from the kayak is an unknown art. Their summer life is the same as that of the inland Eskimos, and their winter life differs from it only in that they hunt seals through holes in the sea ice and use seal blubber for fuel, instead of fishing through the lake ice in the same manner, hunting caribou and musk oxen, and using caribou tallow in the stone lamps. Both groups use the long narrow type of kayak suitable only for lakes and rivers, wear clothing cut after the same general pattern, and have practically the same dialect. For these and other reasons I am inclined to believe that the Copper and Netchilik Eskimos migrated to the coast from inland only a few centuries before the appearance of the Copper Eskimos in Coronation Gulf. This would imply a general movement from inland about seven or eight centuries ago, both to the northern coast line and to the western shores of Hudson Bay; and it is noticeable that in both these regions the same extreme emphasis is laid on the distinction between sea and land products, a distinction that is much less pronounced in other Eskimo tribes. The natives on the shores of Hudson Bay, who have a more strictly littoral culture, may have been influenced by older littoral tribes in Baffin Island, who have hardly affected the Netchilik and Copper Eskimos owing to the greater difficulties of communication.

The primary cause for this migration, if my theory holds good, was pressure from expanding Indian tribes. Not all the inland Eskimos, however, were driven out to the coast. A considerable number were congregated in the barren lands north of the Thelon River, whence many of them returned south as soon as the pressure was removed. Thus we learn from Hearne's narrative that the basin of the Kazan River was Chipewyan territory in his day; but shortly after his journey a rapid decline set in among the northern Indians, their hunting grounds became more restricted, and the Eskimos gained (regained?) control of the Kazan basin. Tyrrell,[6] in 1893 and 1894, discovered between five and six hundred Eskimos along this river, all inland natives who only visited the coast for trade. Almost certainly they had not abandoned the coast for an inland life but had migrated south from the barren lands between Backs River and Boothia Peninsula.

If later investigations confirm this theory of a migration of inland Eskimos to the coast some time after 1000 A. D., it will pave the way for still larger issues. The Eskimos of Southampton Island in Hudson Bay, for example, whose primitiveness has remained an unexplained enigma, may perhaps be interpreted as a small first wave that moved out farther than the rest and became isolated, thereby escaping the cultural influences that affected the rest of Hudson Bay. The theory will involve also the perhaps synchronous migrations from Baffin Island into Greenland and raise the problem as to whether the same causes may not have operated in this movement also, although here it mainly or exclusively affected coastal tribes. Finally there would remain the question of the connection between the western and the eastern coastal Eskimos and of both of these with the inland tribes.

In regard to the often-discussed problem of the ultimate origin of the Eskimos and their peculiar civilization I have no opinion to offer. The theories outlined above deal only with the history of a small portion of the race during the last thousand years. If they concern an area which, in the opinion of some of the ablest ethnologists, saw the transformation of an original inland, proto-Eskimo population into the littoral Eskimos that we know today, my theories need not be considered as running counter to that opinion, because such a transformation, if it ever did take place, must have occurred many hundreds of years before the Christian era. But a permanent solution of the entire Eskimo problem can hardly be satisfactorily attempted until more excavation has been done among the ancient ruins of Canada and Alaska and additional studies have been made of the living Eskimos in parts of both these countries.

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[6] J. B. Tyrrell: Report on the Doobaunt, Kazan and Ferguson Rivers, *Ann. Rept. Geol. Survey of Canada*, Vol. 9 (N. S.), 1896, pp. 1 F–218 F; reference on p. 167 F.

A WOOL MART OF THE INDO-TIBETAN BORDERLAND

By H. Lee Shuttleworth
Indian Civil Service

Immediately to the south of the Maharaja of Jammu and Kashmir's territory of Ladakh, or Little Tibet, as English writers used to call it, a narrow tongue of British India runs eastward to meet independent Western Tibet. The end of this tongue comprises the cantons of Spiti and Lahul both of which tracts politically belong to the Kangra District of the Punjab.[1] South of Spiti lies the native state of Bashahr. After the first Sikh War in 1846 the British Government retained this strip of country, barely 120 miles wide north to south and mostly consisting of sparsely populated and barren mountain wastes, in order to secure a route under its own control between the wool districts of Tibet and the Punjab plains. This was thought necessary, as in those days traders were subjected to innumerable delays and imposts, both authorized and unauthorized, in the hill states through which they had to pass. Now that roads are improved and vexatious obstacles to trade have been removed, a considerable volume of trade from Tibet passes through Kashmir; but still a fair amount reaches the Punjab through Lahul and Kulu. This is largely owing to the enterprise of the Lahul people, keen traders who, speaking the Tibetan language and being used to Tibetan conditions, do not find it difficult to negotiate with the pastoral nomads of the high steppes.

The Source of the Wool

The part of Tibet from which comes the bulk of the wool and certainly the best of it, is the Chang Tang, or "Northern Plain," lying north of Nari Khorsum, the district which contains the sources of the Indus and Sutlej, and northwest of the Tsang-po valley, in which are situated Lhasa and most of the settled portions of Tibet. Geographically it extends into Rupshu, politically a part of Kashmir. The Chang Tang has been aptly described as "a wind-swept expanse of bare mountains and shallow valleys filled with brackish lakes, that find no outlet for their waters. Hardly anywhere does the surface sink below the level of the highest point of the Alps." There are no real villages in the Chang Tang. The inhabitants dwell in low black tents of yaks' hair, in shape much like those of Bedouins, and shift their encampments about according to the season to obtain the best grazing. Most of the grazing grounds lie between 15,000 and 17,500 feet. The snowfall is small, far less than farther west in Lahul. Even in the winter months a certain amount of grazing can be obtained, as the violent gales of wind blow away the hard fine snow from the more exposed parts of the lower slopes. During the same season in the less elevated valleys of Spiti and Lahul, between 10,000 and 14,000 feet high, no grazing is possible, for the snow lies to a depth of eight feet or more: flocks and herds have to be stall-fed and are confined to the lower stories of the houses. At the same time the cold in the Chang Tang is intense and penetrating. The animals, domesticated and wild, which inhabit that inhospitable region, have been provided by nature with suitable warm coverings for their bodies. The fleece of the sheep is of very long firm staple, up to six inches and even sometimes a little more, though rather harsh in texture. These big long-legged sheep of the Tibetan nomads of the "Northern Plain" are known as the "Northern" animal or "Byang-gi."[2]

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[1] For further description see the author's paper: Border Countries of the Punjab Himalaya, *Geogr. Journ.*, Vol. 60, 1922, pp. 241–268.

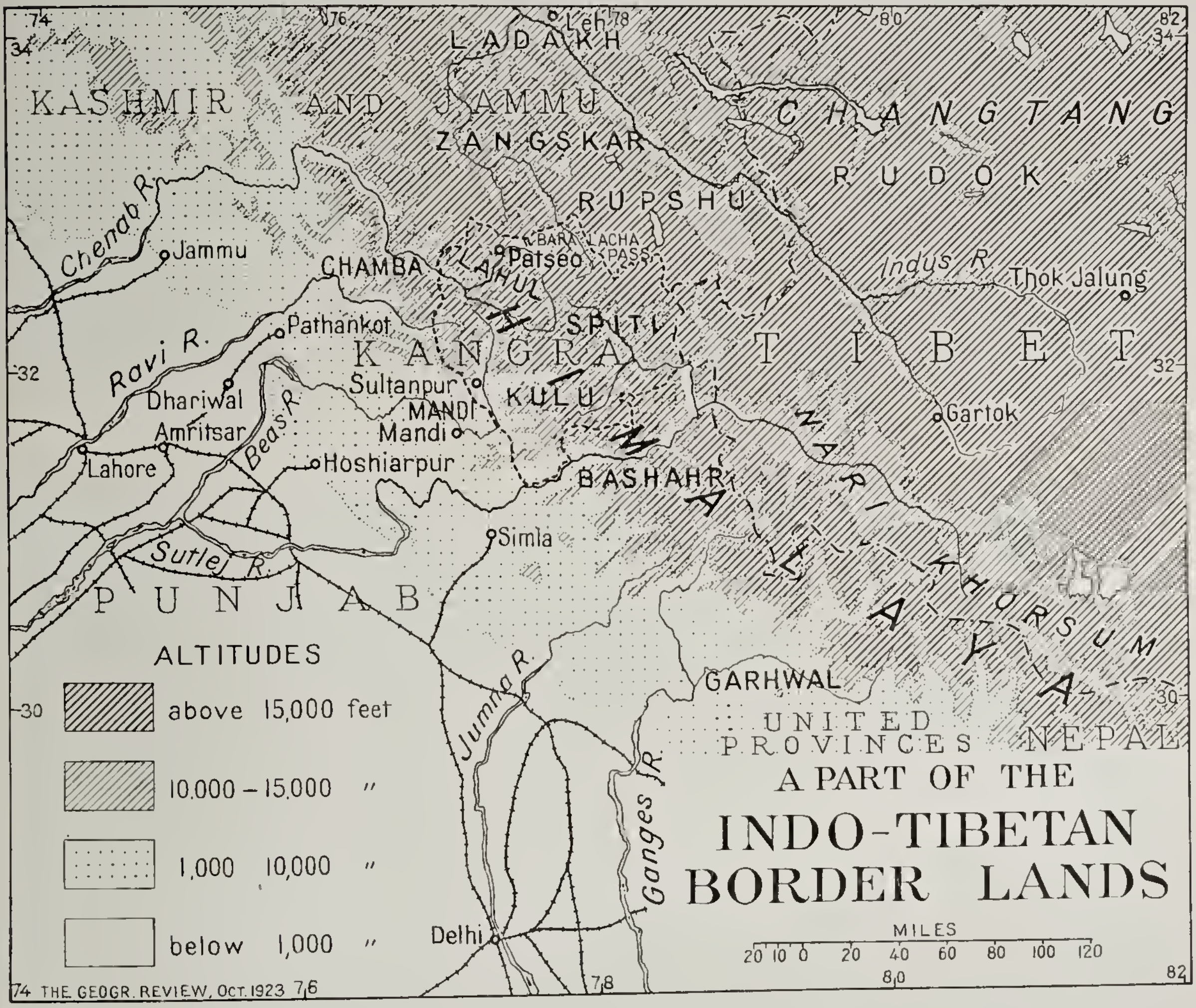

FIG. 1—Map showing the situation of Patseo, a wool mart of the border region between the highlands of Tibet and the northern plain of India. The boundary of the administrative subdivision of Lahul, Spiti, and Kulu is shown by a line of dashes. Scale of map approximately 1: 6,500,000.

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[2] The word "Byang" is interesting as it represents the original pronunciation of the Tibetan word for North, "Chang." "Chang" is still written as "Byang" in the Tibetan. The termination "-gi" merely indicates a genitive or turns the preceding noun into an adjective.

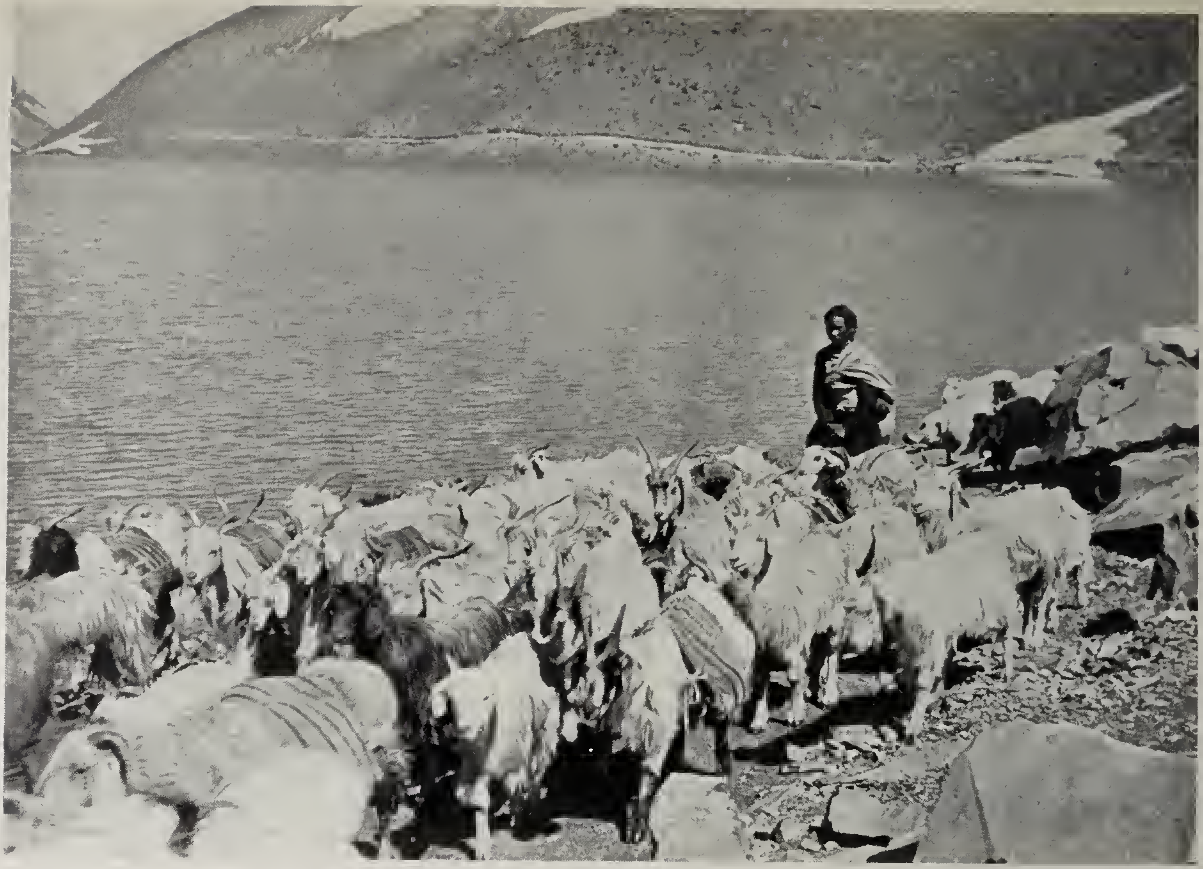

FIG. 2

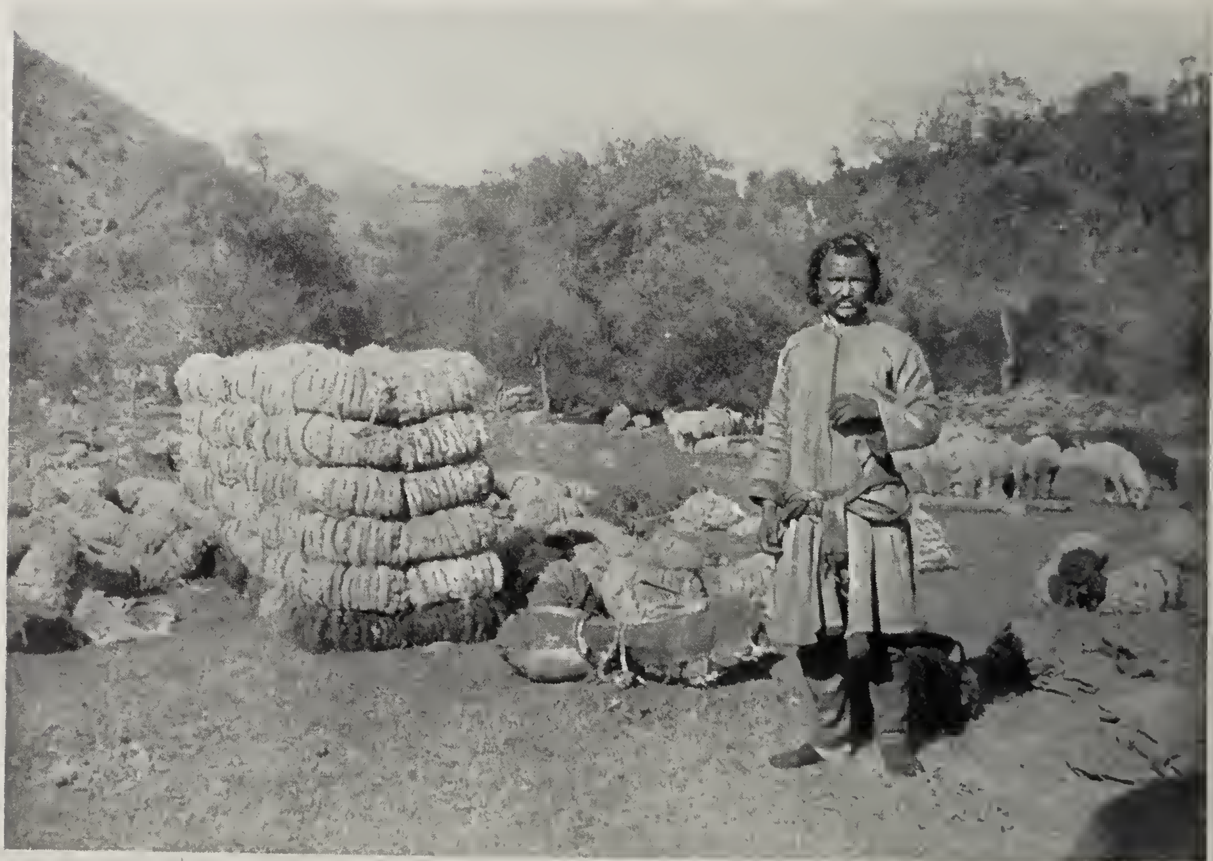

FIG. 3

FIG. 2—Lahul pack sheep and goats ascending the Baralacha Pass, 16,047 feet high (see map, Fig. 1). They are taking up grain to Western Tibet and will bring down wool.

FIG. 3—Bales of wool from Patseo on their way to Sultanpur in Kulu. The Lahula is taking them down on his sheep and goats.

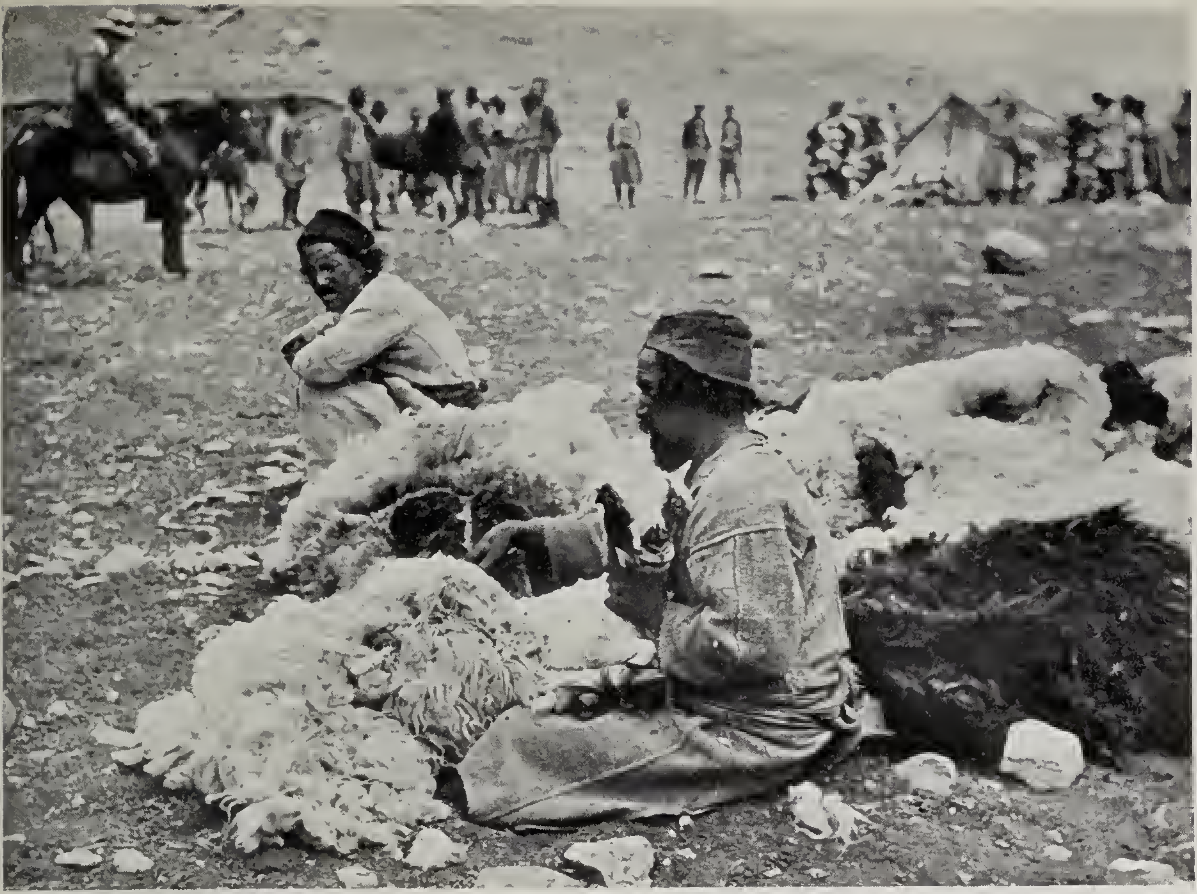

FIG. 4

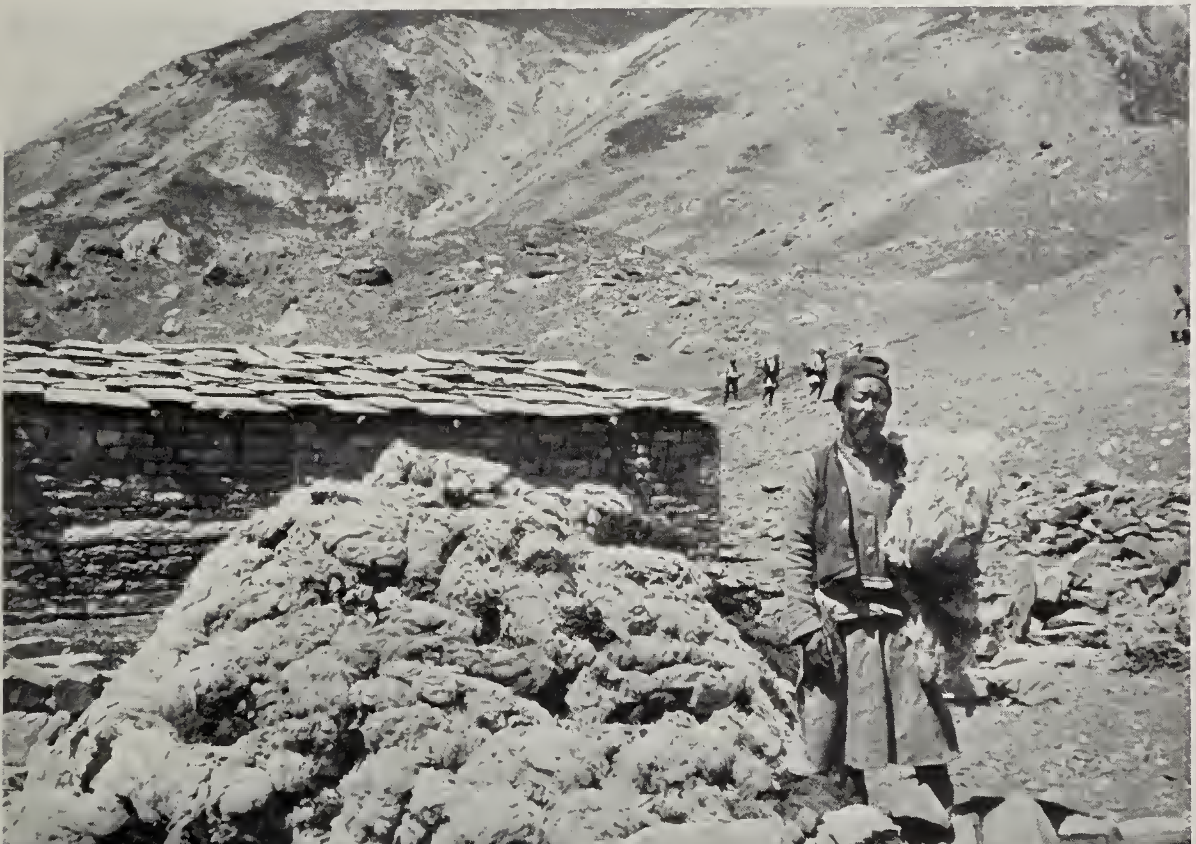

FIG. 5

FIG. 4—A Lahula shearing sheep at Patseo.

FIG. 5—A heap of fleeces by a stone shelter at Patseo with a Lahula. The men in the background are Gaddis.

Situation of the Wool Mart

Many Lahulas either own flocks of these Chang Tang sheep or are shareholders in them with the Tibetan Chang-pas. Other Lahulas pay advances for the wool they will want in the coming year. The result is that practically all the wool that enters Lahul is in the hands of a small number of dealers, and outside buyers have little chance of obtaining any quantity. Nowadays the wool mart is situated at Patseo, or Do-zam, to give it its Tibetan name, on the Bhaga River. The name, meaning "stone bridge," has outlived the natural bridge whose existence it commemorates. This bleak spot is ten miles west of the Baralacha Pass on the Great Himalayan Range and eight miles to the northeast of the last Lahul village of Darcha. The little stony plains that lie on either side of the Bhaga are nearly 13,000 feet above sea level. The Chang-pas and their flocks are not supposed to thrive at low elevations: certainly they do not enjoy them. However, it is said that in old times they traveled 25 miles farther southwest down to where the Bhaga joins the Chandra at a little below the 10,000-foot level. From this instance and another in Spiti, in which within the memory of man the mart has been shifted nearly 40 miles eastward, it will appear that the ever increasing demand for wool has induced the merchants to travel farther and farther toward the wool producers' country, reducing the journey for the shepherds and their flocks. Even as it is, some flocks bound for Patseo may have to travel for a month or more from their grazing grounds beyond the Indus, perhaps 150 or 200 miles away, while those from neighboring Zangskar or Rupshu have to be on the move for at least a fortnight. For flocks must travel slowly and have ample time to graze.

It will have been gathered that the bulk of the wool that comes to market is carried there growing on the sheep. But some animals are shorn at home, and their wool is brought in small bales on the backs of sheep or goats—the common carriers of roadless Tibet. Elsewhere in Tibet and in Lahul and Kulu sheep are clipped at least twice a year, but here shearing is done only once in the year in late July or August. At this time great flocks of long-fleeced sheep, each flock consisting perhaps of a thousand or so in charge of two or three wild-looking men and a few fierce Tibetan mastiffs, and many smaller flocks of pack sheep and goats all proceeding westward, will be met with on the desolate 46-mile stretch of road between Patseo and the great upland plain of Lingti, 14,600 feet high, where Spiti, Lahul, and Ladakh meet. As far as Lingti there is a fair mule road, which then turns north to Leh. But beyond here to the east made roads are nonexistent.

Trade at the Mart

For a whole month at this time every available piece of ground at Patseo, among the rocks as well as on the little plains, is occupied by tents, men, animals, piles of fleeces, bags of salt and borax from the East, and bales of cotton cloth, packages of tea, and bags of grain from the West. The merchandise from the Punjab plains and Kulu or Lahul is carried up on ponies or pack sheep and goats of breeds different from those they meet at Patseo. The same animals, with more bought from the Tibetans, take down the wool. A pony load is from 160 to 200 pounds or more according to the condition of the road. Men from Kulu and a few Lahula women also take away loads of 60 or 70 pounds on their backs in "kiltas," the conical baskets used by hill folk throughout the Himalaya. Owing to the nature of the transport possible on these roads trade here must always remain on a small scale as compared with lands where railways or waterways are available. In the year 1918–1919 imports by this route consisted of 3878 maunds of wool and 5820 maunds of salt, each maund equal to 82 pounds. Also in the same year 9050 live sheep and goats were imported, and no doubt many of the sheep were shorn later. If we calculate the total imports of wool, salt, borax, and other articles in pony loads, about 5000 ponies, quite a respectable number, would be required for transportation. But the wool entering by this route is only a small part, a little more than one tenth, of the total wool imports from Tibet to British India, which in 1915–1916 amounted to 1346 tons. That this is so is not surprising when we remember that Patseo is some 255 miles from the railroad at Pathankot, whence the wool goes to the mills at Dhariwal and to dealers at Amritsar.

During August the human population of Patseo is made up of most varied elements. Besides Lahulas, Chang-pas, and others from independent Tibet we meet with Zangskaris, Spitials, Khampa gypsies, originally from Kham in far eastern Tibet and now wanderers between Patseo and the plains, Kuluis, and a few tall Gaddis from Kangra or Chamba. The Gaddis keep immense flocks of sheep that supply a coarse short-stapled fleece of much less value than that of the Tibetan sheep or even of the local Lahul or Kulu flocks. In the winter these sheep are pastured among the outer hills and in the summer move up to Lahul as far as the Baralacha. Between 100,000 and 200,000 of them cross the passes into Lahul in May and June for the rich grazing available there; but they are shorn near the plains in March and November, and so their wool does not appear at the Patseo mart. The actual sheep shearing at Patseo is done by hand by the servants of the Lahula flock owners or of the purchasers.

Accounts at the market are settled up and the balance due is paid in silver Indian rupees, together with an advance for next year's wool. In this way a large amount of rupees goes out of Lahul into Western Tibet every year. In 1918–1919 Rs.99,893 were recorded as leaving Lahul. In the same year three times that amount of silver went to Tibet and Central Asia from the Punjab by the various routes to make up the adverse trade balance. It is interesting to recall that, while a constant stream of Indian silver enters Western Tibet annually, another stream, one of gold, some of it from Thok Jalung in the Chang Tang, flows out of Eastern Tibet into China. In the year before the Great War £30,625 in Tibetan gold entered Tachienlu alone. But none of this gold enters Lahul. It is strange also that, though Lahul is situated in Kangra, an Indian tea-producing district, some brick tea reaches Patseo and Lahul from far-off China after traversing the whole length of Tibet from east to west. So little grain is grown in the uplands of Western Tibet, though barley ripens there up to elevations of 15,000 feet above the sea, that were it not for the imports of grain from the Punjab and Kashmir, the sparse population would scarcely be able to live. It is mainly due to the large supplies of wool available that the Chang-pas are able to import sufficient foodstuffs from the Punjab and the more fertile parts of southeastern Tibet. Wool is their only real wealth, as the Tibetan Government has a monopoly of gold.

The wool that leaves Patseo does not go straight down to the railway. The bulk of it is carried by the Lahula pony men through Lahul and over the 13,000-foot Rohtang Pass down into Kulu. There at the town of Sultanpur, 90 miles from Patseo, it is sold either to down-country purchasers from Amritsar, Dhariwal, and Hoshiarpur or to local dealers, who will distribute small quantities to consumers in the hills. Most of this buying and selling takes place during the Kulu Dussehra fair, when large crowds from all parts attend Sultanpur to join in the religious festival or engage in trade. Long before then, even in late August, Patseo, a short time before so full of life and activity, is deserted, with nothing left to remind one of the wool market except the stone shelters and the low walls where tents are pitched from year to year. The only animals to be seen now are herds of ibex that come down to lick the stone slabs on which the Tibetan salt has been piled. From October to April deep snow covers the ground and closes the passes.

THE GEOGRAPHY OF PASTORAL LIFE

ILLUSTRATED WITH EUROPEAN EXAMPLES

By Philippe Arbos
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The term pastoral life is applied to a mode of human activity characterized by two essential features. It is founded on the exploitation of live stock: it involves periodic movements of the stock as they exhaust the resources of their encampment.[1]

Pastoral life is not the necessary outcome of natural condition. As all other forms of activity it presupposes active intervention on the part of man in utilizing the material furnished by his environment. There are countries where, despite wealth of live stock and extent of suitable domain, man has failed to put the two in combination and thus take advantage of resources with which nature has liberally endowed him. Such animal stocks as the bison, caribou, musk ox, and Rocky Mountain sheep have thus remained unproductive.[2] Broadly speaking, pastoral life was foreign to the New World until the advent of the Europeans.[3] In the Old World such people as the Chinese and Japanese, absorbed in a traditional practice of agriculture, have made little use of their mountains for pastoral purposes.[4] Nevertheless it is the Old World that embraces the greatest realm of pastoral life.

The Three Fundamental Forms of Pastoral Life

Pastoral life presents itself under three principal forms: nomadism, transhumance, the pastoral life of the mountain.

Nomadism is that form under which the entire human group accompanies the flocks and herds in their migrations. When care of the animals is delegated to shepherds and the rest of the group remains sedentary we have transhumance.[5] The term "pastoral life of the mountain" is applied to those movements which simply involve passage between the lower and higher parts of the same mountain slopes.

Varieties of Pastoral Life

These summary definitions do not cover all the complexities of phenomena to which pastoral life has given rise and which are infinitely varied. From sedentary life to nomadism, to transhumance, and to the life of the mountain there is every shade of transition. Thus certain folks about the source of the Irrawady live as nomads except that their dwellings are not tents but little villages of gray stone or wood.[6] The Shawiya of the Aures (Algeria) pass some months in their houses on the plains but live the greater part of the year under the tent.[7] In Morocco the Beni Mguild of the Middle Atlas combine agriculture now with nomadism, now with the pastoral life of the mountain. They have houses on the high plateaus, whither they conduct their flocks in the summer, and others in the valleys where they gather the harvests; while during the winter they live under the tent and pasture their flocks on the plains.[8] Similar diversified forms are found among certain peoples of Corsica. From autumn to spring these folks live in rude huts on the shore, pasturing their flocks and engaging in a somewhat precarious cultivation; then, crossing a belt occupied by the fields and villages of the sedentary agriculturists, they reach their stone villages in the chestnut country. Here a part of the group is installed, but the shepherds continue with the flocks to the high pastures and remain till the end of September.[9]

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[1] See Philippe Arbos: La vie pastorale dans les Alpes Françaises; Étude de géographie humaine, Paris, 1922.

[2] Reference may be made to Vilhjalmur Stefansson's proposal in "The Northward Course of Empire," 1922, to domesticate the musk ox or "ovibos."

[3] There is a notable exception in the pastoral economy of the Incas. Llamas and alpacas must have been domesticated in early times. At the arrival of the Spaniards elaborate rules were in existence for care of the flocks.

[4] Paul Vidal de la Blache: Principes de Géographie humaine, Paris, 1922, pp. 144 and 146.

[5] On the distinction between nomadism and transhumance, see Augustin Bernard and N. Lacroix: L'évolution du nomadisme en Algérie, *Ann. de Géogr.*, Vol. 15, 1906, pp. 152–165.

Other variations arise from the combinations of still other activities with stock raising or again where physical contrasts provoke other responses than those mentioned above. As an illustration of the former we may cite the Ostiaks on the Siberian slope of the Urals, who send their reindeer to summer on the mountains under common shepherds while they devote themselves to fishing, reassembling with their herds in the villages during winter. Similar periodic migrations obtain among the fishing Lapps of Finland and the Kola peninsula.[10] An illustration of the latter is furnished by the Beirs, dwelling between the Sobat and the White Nile, who during the dry season occupy temporary habitations in the inundated zone from whence they are driven during the rainy season to their permanent villages in the highlands.[11]

Evolution of the Forms of Pastoral Life

Just as they are far from simple, so are the varieties of pastoral life far from immutable. Fifty years ago shepherds of the Veles massif in the Dinaric Alps lived a truly nomadic existence. They had no agricultural occupation; no proper houses, only temporary huts; they wandered with their entire families and all their worldly goods over the vast stretches of their territory. Today, while they still engage in numerous and complicated wanderings, they have true houses in true villages where a part of the population devotes itself to agriculture.[12] The Corsicans, whose nomadic existence we have described, tend to settle down, some on the shore, others in the chestnut country; only the shepherds maintain the characteristic transhumance.[13] In Algeria the great circles of tents disappear; herds are more and more confided to the care of herdsmen; nomadism here is likely to give way completely to transhumance.[14]

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[6] Jacques Bacot: Le Tibet révolté: Vers Népémakö, la terre promise des Tibétains, Paris, 1912, p. 220.

[7] E. F. Gautier: Native Life in French North Africa, *Geogr. Rev.*, Vol. 13, 1923, pp. 27–39; reference on p. 32.

[8] Suzanne Nouvel: Nomades et sédentaires au Maroc, Paris, 1919, pp. 55–62. For other examples of the variety of forms of pastoral life in French North Africa see Jules Blache: Modes of Life in the Moroccan Countryside, *Geogr. Rev.*, Vol. 11, 1921, pp. 477–502. See also Augustin Bernard and N. Lacroix: L'évolution du nomadisme en Algérie, Algiers and Paris, 1906, and Augustin Bernard: Enquête sur l'habitation rurale des indigènes de l'Algérie, Paris, 1921.

[9] Raoul Blanchard: Les genres de vie en Corse et leur évolution, *Receuil des Trav. de l'Inst. de Géogr. Alpine*, Grenoble, Vol. 2, 1914, pp. 187–238, reference on p. 224.

[10] Charles Rabot: La vie pastorale dans la Savoie septentrionale, *La Géographie*, Vol. 27, 1913, pp. 348–357; reference on p. 356.

[11] H. D. Pearson and H. H. Kelly: The Pibor River, *Geogr. Journ.*, Vol. 40, 1912, pp. 486–501; reference on p. 500.

It appears then in general that the progress of civilization, by furthering the intensive exploitation of local resources, encourages sedentary modes of life. It is only exceptionally that the process has a reverse result. An instance of such an exception is afforded by the tribes of southern Algeria, who since the *pax gallica* have ventured out of their fortified settlements to graze their flocks in security on the steppes.[15] This transformation will be apparent in the present study, which will describe in turn the characteristics and conditions of each mode of pastoral life and illustrate them by examples from Europe and in particular from the French Alps.

Nomadism

Nomadism is a phenomenon of the steppes, whether of latitude or altitude. In both alike the successive exhaustion of the grazing grounds and the sparse distribution of fertile ground make necessary the gregarious and wandering life. On the other hand, the pastoral peoples cannot subsist on pastoral products alone. They must be in touch with agricultural markets situated on the borders of the steppes where they can exchange their products with those of the sedentary peoples. The necessity for this trading determines the rhythm of the migrations.[16]

Whatever their amplitude the nomadic movements are regulated by the course of the seasons, which determine the contrasts between the different parts of the same region, between regions of different latitude, and between regions of different altitude. The 100,000 sheep of the Larbas of Algeria travel from Mzab to the Tell. The Kirghiz annually drive 260,000 sheep the 800 kilometers between the plains of Ferghana and the mountains of Tian Shan.[17] The yaks and sheep of Upper Sikkim, after browsing the summer on the short sweet grass of their mountains, descend when the snows begin to fill the narrow valleys open to the humid south winds and seek winter pasturage on the northern slopes, colder but drier.[18]

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[12] Jetvo Dedijer: La transhumance dans les pays dinariques, *Ann. de Géogr.*, Vol. 25, 1916, pp. 347–365; reference on p. 354.

[13] Raoul Blanchard, *op. cit.*, pp. 230, 234.

[14] Bernard and Lacroix, *Ann. de Géogr.*, p. 164.

[15] *Ibid.*, p. 162.

[16] Compare André Allix: The Geography of Fairs; Illustrated by Old-World Examples, *Geogr. Rev.*, Vol. 12, 1922, pp. 532–569.

[17] Paul Vidal de la Blache: Les genres de vie dans la géographie humaine, *Ann. de Géogr.*, Vol. 20, 1911, pp. 193–212 and 289–304; reference on p. 302.

[18] Jules Sion: Le Tibet méridional et l'expédition anglaise à Lhassa, *Ann. de Géogr.*, Vol. 16, 1907, pp. 31–45; reference on p. 32.

CHARACTERISTICS OF NOMADISM

The migrations are not embarked upon at hazard; they demand agreements relating to the routes, the provision of water, and the ownership of the soil. Thus it has been since the days when Abraham and Lot made a mutual disposition of the flocks and herds and tents in the country of Canaan and the plain of Jordan respectively. Months may pass without parts of these domains being visited by their owners, for the herbage must have time to grow; but, though occupied so rarely, they are not the less a dependency of the group. Such a character, an essential feature of nomadism, can only be realized where vast extents are devoted almost exclusively to pastoral migration. Thus is explained the fact that pastoral nomadism has almost completely disappeared from Europe.

THE LAST EUROPEAN NOMADS

The last European nomads are to be found in the Aromunes or Kutzo-Vlachs of the Balkan peninsula.[19] The nomad Vlachs live during the warm season on the high pastures from the Stara Planina up to the Peloponnesus. When winter approaches they descend with their flocks to the Aegean or the Adriatic seaboards. In May, 1910, Cvijić observed the passage of a band of Vlachs who had wintered in the plain of Saloniki and were then ascending to the Pindus. They had 60,000 sheep in 20 flocks. Each flock was preceded by guards, encircled by dogs, and followed by a number of horses carrying the possessions of the group; the men and women were mounted on horses and asses, the children being carried in baskets slung on either side of the saddle.

The pastoral Vlachs do not practice agriculture; they have no fixed establishments or true houses; they live under the tent or on the mountain in temporary structures, little chalets called *calivas*. Their migrations, in which the entire tribe accompanies the flocks, thus have the essential features of nomadism. It is a vanishing survival of a mode of life formerly of much greater extent in the Balkans.

Transhumance in Europe

In Europe transhumance has retained a much greater importance than nomadism. It is better adapted to the economic state of that continent because it harmonizes with the existence of cultivated areas between the pastoral zones where the transhumants find support of their industry. The fact that these intermediate zones are under cultivation compels the migrant flocks to effect the crossing as rapidly as possible. The presence of women and children and the transportation of personal properties delay progress and increase the chances of conflict with the peoples whose lands are traversed. Transhumance reduces these difficulties by separating the human group from the animal group, putting the latter in charge of some individuals only. Economic reasons also tend to fix the human group. Pastoral exploitation alone is insufficient to support the group, and husbandry is added.

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[19] See Jovan Cvijić: La péninsule balkanique: Géographie humaine, Paris, 1918, pp. 177–180, and A. J. B. Wace and M. S. Thompson: The Nomads of the Balkans, New York, 1913.

The amplitude and relative rapidity of the movements of transhumance tend to exclude large cattle from participation. Furthermore, cows and oxen tend to be raised in large numbers only in regions which are rich enough in pasture to maintain them the year round. Thus transhumance is almost entirely limited to small cattle, especially sheep.

Summer and Winter Pasturages: Plains and Mountains

The transhumants occupy in alternation two complementary zones each of which can support the flocks for a part of the year only—wintering and summering grounds. As the migrant flocks are pastured even during the winter, the cold must not be too rigorous nor too continuous. In Europe the plains bordering the Mediterranean meet the desirable conditions to perfection; the winter is mild and rainy, favoring uninterrupted growth of vegetation. On the other hand, under the burning skies of summer the low country is transformed into dusty and arid steppes. Unless the flocks would perish they must then seek more favorable regions. Nor is this the only reason for leaving the plains. Only exceptionally are these grounds purely pastoral. Most often some agriculture is carried on too. In the course of the annual cycle the fields grazed upon in the winter and fertilized by the flocks are required for crops in the summer. Then the flocks must seek other pastures, and these are available only in the mountains. The European transhumants in general have recourse to the regions of elevated relief afforded by the Tertiary fold mountains bordering the Mediterranean.

Regions of Transhumance

Transhumance is especially practiced in Spain, where more than a million sheep go in summer from the depleted basins and plateaus towards the Sierras, the Cantabrian Mountains, and the Pyrenees.[20] The Pyrenees also receive migrants from the French plains—the basins of Aquitaine and Roussillon.[21] To the grassy summits which crown the eastern border of the Central Massif 60,000 head ascend each year from Lower Languedoc.[22]

At the other extremity of the European chain similar relations are maintained between the Dinarics and the Bosnian lowlands; between the Balkans and the plains of Adrianople, Saloniki, and Uskub; between the southern Carpathians and the Dobruja.[23] The Apennines and the Alps see the arrival in summer of flocks which have wintered in the lowlands. Today, as in the time of Varro, contemporary of Julius Caesar, great flocks of sheep alternate between the winter pastures of the Apulian plain (Tavoliere di Puglia) and the summer pastures of the Apennines. As regards the Alps, it is especially from the plains of the Po and the Lower Rhone—the delta lands of Camargue and the stony stretches of Crau—that the bleating droves arrive.

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[20] On transhumance in Spain see André Fribourg: La transhumance en Espagne, *Ann. de Géogr.*, Vol. 19, 1910, pp. 231–244; see also Julius Klein: The Mesta; A Study in Spanish Economic History, 1273–1836, Cambridge, Mass., and London, 1920 (reviewed in the *Geogr. Rev.*, Vol. 11, 1921, pp. 453–454).

[21] Fribourg, *op. cit.*, p. 242; Max Sorre: Les Pyrénées méditerranéennes: Essai de géographie biologique, Paris, 1913, p. 457.

[22] Max Sorre: Étude sur la transhumance dans la région montpelliéraine, *Bull. Soc. Languedocienne de Géogr.*, Vol. 35, 1912, pp. 1–40.

Transhumance in the French Alps

The number of migrants from Camargue and Crau ascending the French Alps in the summer, ranges from season to season between 250,000 and 300,000. They disperse over all parts of the mountains, save in the southern Prealps,[24] of low altitude and sparse vegetation of Mediterranean type, and northern Savoie, which is too far from their winter quarters. In the rest of Savoie the numbers are greatly inferior to those in Dauphiné and Provence, while within these two latter provinces the migrants are most numerous on the crystalline terrain of the Central Massifs and the limestones of the Prealps.[25]

Ancient Rules for Flocks on the March

Much interest attaches to the migrations of earlier days. The march of the sheep from Provence was made under regulations of almost martial character.[26] Several flocks were gathered into a convoy known in Provençal as *abeiller*, in French as *compagnie*. Such a company at the beginning of the nineteenth century often included as many as 20,000 head; it was controlled by a veritable council of war, the *Robe*, formed of *bayles* (or chief herders) who took their places in the centers of the flocks to give the orders for the march. The company was divided into *scabots* each of 500 to 2000 head. At the head of each *scabot* marched a number of *menons*, old large-horned he-goats carrying great bells; then the finest specimens of the rams, distinguished by tufts of wool left while shearing; the rest of the flock followed, and the procession concluded with pack train and big dogs armed each with a spiked collar.

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[23] Dedijer, *op. cit.:* Cvijić, *op. cit*; Emmanuel de Martonne: La vie pastorale et la transhumance dans les Karpates méridionales; leur importance géographique et historique, in Ratzel-Festschrift, Leipzig, 1904, pp. 225–245.

[24] De Martonne, *op. cit.*, p. 239; also A. Grenier: La transhumance des troupeaux en Italie et son rôle dans l'histoire romaine, Mélanges d'archéologie et d'histoire, Vol. 25, 1905, pp. 293–328, École française de Rome, Paris.

[25] On the different regions of the French Alps see Raoul Blanchard: The Natural Regions of the French Alps, *Geogr. Rev.*, 1921, pp. 31–49.

[26] For conditions of transhumance in earlier times in the French Alps see J. E. Michel: Observations sur le commerce des bêtes à laine dans les départements des Bouches du Rhone, des Basses Alpes, et du Var, Aix, 1790; and Joseph Fournier: Les chemins de transhumance en Provence et en Dauphiné d'après les journaux de route des conducteurs de troupeaux au xviiie siècle, *Bull. de Géogr. Hist. et Descriptive*, Vol. 15, 1900, pp. 237–262.

The Old Routes of Transhumance

These armies of beasts traveled by special highways, as they have done in every country where transhumance has been important. In the earlier days roads were not only few but were so narrow as seriously to impede the passage of a large body. Where the flocks crossed the cultivated zones it was necessary to reserve for them broad pathways. Such were the *camis ramaders* of the Catalan Pyrenees, the *drayes* of the Cevennes, the *drumul oilor* of Wallachia, the *tratturi* of Italy, the *cañadas* of Spain.

The routes which led to the French Alps from the Provençal plains were the *carraires*; the major roads were 10 to 20 meters wide, minor roads 4.50 meters; both were much narrower than the *cañadas*, the *cordeles*, and the *veredas* of Spain which measured respectively 75 meters, 37.50 meters, and 20.50 meters.

Conflicts Between Transhumants and Agriculturists

In the course of their journeys the transhumants were in perpetual conflict with the peoples whose lands they traversed. The relations between them varied; according to the country, the pastoralist oppressed the agriculturist or vice versa. In Italy and Spain the advantage lay with the transhumants. The Pontifical state and the Neapolitan state, deriving substantial revenues from the taxes collected from them, favored the pastoralists, notably by the imposition on private property of the duty of providing pasturage. In Spain the sheep owners formed the powerful association, the Mesta, which became truly a *chose royale.* The flocks of the Mesta enjoyed three fundamental privileges: the rights of pasturage and water everywhere on the sole condition that no harm was done to grainfields, vineyards, gardens, hay meadows, or ox pastures; exclusive usage of the pastoral highways; exemption from certain imposts and the right to cut wood. As the Mesta was charged with making these privileges respected, it had its own judges for the punishment of offenders. It exercised a real oppression on agriculture, especially during the time of Ferdinand and Isabella and Charles V, under whom its authority was carried to the highest point.[27]

It was quite otherwise in the French Alps. While the transhumants did not entirely lack official patronage, they never enjoyed prerogatives similar to those of their more fortunate confrères in Spain and Italy. The difference is to be accounted for in the lesser development of the pastoral industry and the more advanced state of husbandry in Provence and Dauphiné. The fiscal revenues which transhumance brought to the state were not considerable enough to gain concessions at the expense of agricultural prosperity. Agriculture was more intensive and the rural population denser. In contrast with what obtained in Spain, disputes between the transhumants and the cultivators were submitted to local judges, who did not hesitate "to bear a heavy hand on the stranger." Whoever wielded a scrap of authority used it to lay maximum imposition on the transhumants. In addition to taxes and tolls to which they were regularly subjected the pastoralists had to offer bribes on all and sundry occasions. Nor did they fare any better at the hands of the peasantry; the villagers never failed to attach any animals that strayed from the flock; they were in the habit of letting down the hedges of their properties at the approach of the troops to provoke damage for which excessive compensation could be demanded. Minor persecutions were multiplied; the animals were prevented from watering at the streams; or they were compelled to take a road such as to cause them "to drown or to perish of hunger;" or forced to cross "a narrow mountain crest." These were eighteenth-century episodes in the strife between husbandmen and shepherds in the French Alps.

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[27] Julius Klein, *op. cit.*

Present-Day Roads of Transhumance

Today the triumph of the husbandmen is almost complete. The transhumants, deprived of their privileges, must submit to the common law. They have even lost their old highroads, of which only the memory remains. Their territory has been invaded by the neighboring landowners, who have extended their fields thereon. The sheep today reach the mountains by the ordinary roads—which are, however, better suited for the purpose—and their passage, at least in the French Alps, has been shorn of its picturesque trappings of former days. Today one never sees a company of 20,000 head. Each flock proceeds individually under the charge of several herders. The goats that marched at the head have disappeared. The flocks make a lengthy halt at midday, preferring a long stage in the cool of the night. From one time to another the shepherd buys right to pasture his flock in a meadow, especially such as border the route; but under these conditions they arrive at the mountain meagerly enough nourished.

Because of the inconveniences of these journeys on foot they tend to be superseded by the railroad. This practice has been followed in Spain since 1899 and in France from an earlier period still. It was in 1875 that the Paris-Lyons-Mediterranean line initiated the movement by placing special cars at the disposal of the transhumants. Fifteen or sixteen cars accommodate 1000 head with all the necessary equipment. It is a mode of travel used almost entirely for flocks whose summer and winter encampments are far apart. In 1920 five-sixths of the sheep coming from Camargue and Crau to the mountains of *département* Isère used the railroad.

Decadence of Transhumance

Transhumance, while still retaining a real importance, is sadly diminished from its former estate. In Spain the numbers of transhumants have declined from over 3,000,000 in the sixteenth century till at the end of the nineteenth they do not exceed 1,300,000 to 1,400,000. The decline is similarly marked elsewhere. At the end of the eighteenth century Camargue and Crau sent only 500,000 head; today the figure can be put at 300,000. Various causes account for this decline. It is due in part to the general advancement of agriculture, which takes precedence over pastoral industry, to the more intensive utilization of the land, and to decline of fallowing; and in part it is due to the change in the pastoral industry itself. Strong protests against the depredations committed by passing flocks are made by the agriculturists, in which they are supported by the authorities. In fact, the authorities have not only ceased to support the pastoral interests, but have actively opposed them. In the French Alps in the nineteenth century a veritable crusade has been raised against the transhumants. It has been based on deterioration of the mountains; ruining of the forests and pastures being ascribed to them. The administration has prohibited the use of lands within certain areas set aside for afforestation and everywhere has limited the numbers permitted to graze. It has even approved the suppression of transhumance.

We do not believe this last extremity to be desirable. If the practice was harmful in the past this cannot be charged against the greatly reduced numbers of today. On the contrary, transhumance permits utilization of high pastures in a way that cannot be accomplished by local flocks, while in spite of the progress that has been accomplished on the plains of Provence these can never be made to support such numerous flocks the year through.

Transhumance rests on a geographic basis; its antiquity is not significant of routine but of adaptation to natural conditions. It expresses the solidarity that exists between mountains and plains; what an author of the eighteenth century called with reason "a mutual help based on mutual interest." As transhumance is born of contrasts of altitude so also is the pastoral life of the mountain.

The Pastoral Life of the Mountain

The peculiarity of the pastoral life of the mountain lies in the fact that the movements take place within the same massif, where they are effected between the upper and lower parts of the slopes. In winter men and beasts are gathered in shelters which have a permanent quality because they are the centers of cultivated areas. With the commencement of the good weather the flocks are taken to pasture on the summits round temporary shelters. It is a general phenomenon in the mountains of the Old World, whether in the chains of Tertiary fold mountains or the old massifs with relief rejuvenated through uplift or the superposition of volcanic masses. In Asia the Mantze of Szechwan leave their houses in the summer for pastures at 3500 meters elevation and more. The inhabitants of Nepal, Bhutan, and Kashmir have their summer chalets, similar without doubt to that Shamlegh which Kipling has described in "Kim." In Europe Balkans, Carpathians, Alps, Pyrenees take to their summits flocks from the valleys for the summer. The crests of the crystalline horst of the Vosges and the volcanic mountains of the Central Massif are frequented in the same way.[28] On the Scandinavian shield comparatively low altitude is balanced by the northerly climate, and chalets at 600 or 700 meters welcome to the lichens and heaths of the Udmark, hill pasture, animals which have been stall-fed in the winter on hay gathered in the cultivated lands of the Indmark, the home fields.[29]

Pastoral Life of the Mountain Founded on a Combination of Husbandry and Stock Raising

If the pastoral life of the mountain is thus balanced between permanent and temporary habitations it is because the human groups devoted to it practice agriculture in the first instance and stock raising in the second. This combination is the capital fact. It is well illustrated in the French Alps.

It may be said that stock raising is the vocation of the French Alps. It is conditioned on the existence of vast stretches of natural grazing grounds covering the slopes at altitudes at which the climate becomes too harsh for forest growth. This is the alpine zone of the botanist. These high grasslands, however, are not restricted to the alpine zone. On the lower border they invade the forest. Considerable areas primitively wooded have been converted by man into grassy lawns for which M. Flahault has proposed the term "pseudo-alpine prairie." Alpine prairie and pseudo-alpine prairie together constitute what the mountaineer of the French Alps calls "alp" or "mountain," what we have also designated here as the pastoral zone.

The great spaces of the pastoral zone, which in at least half of the French Alps covers more than 40 per cent of the surface, can only be economically exploited for summer pasture.[30] But why, one may ask, cannot these high meadows be mown and the hay carried down to the farms? In the first place, the available ground is too scattered and difficult of access; in the second, it is too rough topographically for profitable cultivation. A hectare of good mountain meadow produces scarcely 700 to 800 kilograms of hay a year. This inferiority of the high meadow is aggravated by the difficulty of transport to the villages. Considerable differences of altitude separate the permanent dwellings from the alp. They are connected by narrow zigzag paths along which the return journey by mule takes 6 to 7 hours. The price of hay gathered under such circumstances is exceedingly high. Furthermore, since the mountaineers have diminished in number, the remaining population tends to increased utilization of the free pasturage of the alpine zone in place of hay meadows.

But, one may ask further, why does not this population establish itself permanently in the alpine zone? Nature is too hostile. The climate is too harsh for cultivation. Even the hardy grains, barley, oats, rye, can hardly stand the rigors—the frosts early and late, the short season for reaching maturity. The area given to crops in the alpine zone has always been limited and is diminishing. Not that the pastoral zone can be described as uninhabitable. There are, in fact, villages or permanent hamlets at higher elevations than many an alp. But existence there is rude. It is often difficult to secure adequate protection against the keen cold of the long winter. In the high valleys of Tarentaise, Maurienne, Briançonnais, Oisans, and Ubaye, where the forests, never very extensive, have been heedlessly destroyed, the inhabitants are reduced to using sun-dried cow dung or excrement of sheep and goats for fuel; sometimes to supplementing the scant source of heat by living in the stable with the animals. This comfortless existence may become a veritable durance under stress of weather. In the month of January, 1915, for instance, no one could set out from or enter Bonneval in Maurienne without risk of death. The tempest tossed a man about like a straw; and avalanches fell all around. Under such circumstances one realizes why the pastoral zone remains without permanent habitation.

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[28] Pierre Boyé: Les hautes-chaumes des Vosges, Paris, 1903; D'Alverny: Les hautes chaumes du Forez ou l'histoire des bois et des montagnes pastorales de cette province à l'entour de Pierre sur Haute, Montbrison et Paris, 1907; Paul Roux: Le montagnard auvergnat, *La Science Sociale*, No. 113, Paris, 1914.

[29] Camille Vallaux: Le pays de Voss et du Hardanger Fjord, *Ann. de Géogr.*, Vol. 20, 1911, pp. 396–410.

[30] See Philippe Arbos, *op. cit.*, pp. 87–127.

Increasing Area under Forage Crops in the Agricultural Zone

During the bad season the flocks find asylum in the agricultural zone which occupies the lower portions of the mountain valleys. The French Alps have been so actively attacked by the forces of erosion that even the highest and most massive regions enclose relatively low areas. There is not a single high valley where one does not find a stretch, limited though it may be, below 1500 meters in altitude. Hence everywhere agricultural life can gain a foothold.

This agricultural zone has long furnished support for man as well as his animals. In fact, up to the later nineteenth century the backward state of communications due to the difficulties of topography compelled the inhabitants of the French Alps to be self-supporting. A proportionally large area was devoted to crops. But, as the mountain was penetrated by roads and railroads, even the most remote villages began to import grain and flour, and concomitantly the area of tilled land diminished. The ground formerly under cereals has been given over to cultivated and natural forage. The area under cultivated grass has been especially extended in the southern Prealps and in the Subalpine valleys of the south. In all these regions where climate of Mediterranean tendency to drought is inimical to the natural growth of grasses the soil with the aid of chemical fertilizers today yields in abundance leguminous crops—clover, lucerne, sainfoin. The natural prairies are preponderant in the northern Alps, where the humidity of the air is favorable, and again in the intra-alpine zone, where the cost of transport for chemical fertilizer is heavy. But natural or cultivated meadows today take first place in the agricultural zone of the Alps.[31]

SEASONAL MIGRATIONS BETWEEN THE PASTORAL ZONE AND THE AGRICULTURAL ZONE

The strong declivities greatly increase the actual distance between the agricultural and pastoral zones. The journey between them may be not only long and tedious but too hazardous to be undertaken as a daily routine. Certainly it is exceptional for the cattle to have to spend nine hours on the journey to their pastures, yet such is actually the case in Termignon (Maurienne). Even on the average it takes from an hour and a half to three hours. Furthermore, there is a positive advantage in pasturing the animals on the alp during the summer. Thus arises periodic migration in place of the daily journey.

Pastoral life is not always reduced to a simple rhythm between the high pastures and the permanently occupied region; for in the intervening zone, which is often extensive, man and animals can find other resources. To add to the winter forage and to assure the flocks grazing grounds on the way from stable to alp, the mountaineers have cleared the forest for pasture and have planted fields for their own needs. The intermediate stage of exploitation thus constituted is frequently associated with a temporary habitation. Thus the migrations assume complexity.

The domain of each human group engaging in the pastoral life of the mountain is thus extended in a vertical sense; stages of exploitation are superposed, mostly two, sometimes more than two. Naturally the same stage is not found everywhere at the same altitude. In reference to this we may note Toniolo's apposite observation that the bottoms of the valleys constitute an anthropogeographic base level;[32] in measure that one proceeds upstream, so rise the levels of the various forms of exploitation. This is not only the result of physical conditions; human activity also plays its part. Downstream the peasants have lowered the upper limit of the forest to gain a broader margin for their pastures and uncertain crops. Upstream they have created intermediate pastures or fields, the higher as the villages are the more elevated. Thus it is altitude that is the real master of the life of the mountain. We shall now examine its workings a little more closely.

THE MOUNTAIN

The two extremes between which the pastoral life circulates are the permanent habitation of the agricultural zone, the village, and the temporary habitation of the pastoral zone, the mountain. The mountain is classified according to the animals carried—sheep or cattle. If the latter, there may be specialization in the way of meat production, if the animals are fattened, or milk production. In the case of all except the milk-producing mountains a few shepherds suffice to care for the stock. Summer migrations of the animals then do not involve human migrations of any extent. It is different if the mountain is devoted to milk production. This requires a numerous personnel.

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[31] See Philippe Arbos, *op. cit.*, pp. 121–143, 234–258.

[32] A. R. Toniolo: Ricerche di antropogeografia nell'alta Valcamonica, *Memorie Geogr.* (*Suppl. to Riv. Geogr Italiana*) *No. 23* (=Vol. 7, pp. 243–362), Florence, 1913, p. 348.

Again, distinction may be made between the "great mountain" (*grande montagne*) and the "little mountain" (*petite montagne*). In the former, exploitation is concentrated; a great number of animals are placed under the care of a small number of herders; in the second, exploitation is individual and dispersed; each family goes to the alp with its flock. Thus the "great mountain" displaces only a small part of the population; on the contrary, in the country of the "little mountains" the valleys are temporarily depopulated. Furthermore, while the "great mountain" is purely pastoral the "little mountain" often supports crops.

The pastoral zone must not, however, be conceived of as restricted in each section to one and the same type of mountain. It is only in the southern Prealps that one finds sheep exclusively. Elsewhere various modes of exploitation coexist. In regions of the Provençal mode of life sheep occupy the upper part of the alp, oxen the lower; in Savoyard regions sheep, oxen, milch cows succeed one another from above downward as the grasses become thicker and more luxuriant with descent.

THE VARIETIES OF MIGRATIONS: SIMPLE MIGRATIONS

Simple migrations between village and mountain obtain, as a rule, where the differences of altitude are not sufficiently great to give place to an intermediate stage. Simple migrations arise from peculiarities of relief in the Prealps of moderate altitude and in the highest parts of the valleys of the Intra-alpine zone—Upper Tarentaise, Upper Maurienne, Briançonnais in general, Queyras, Upper Embrunais, Upper Ubaye. In the Prealps, village and mountain are characteristically separated by abrupt limestone scarps. In the high valleys, as a result of glacial erosion, the slopes are precipitous from the trough to the shoulders, which are often at a considerable altitude. Similar effects explain the existence of simple migrations in certain of the central crystalline massifs which have kept a pronounced freshness of form—Oisans, Pelvoux, Mont Blanc, Aiguilles Rouges; while in others—Taillefer, Belledonne, Beaufortain—the slight differentiation of relief leads to the same result. Belledonne, for instance, is in a chain comparatively little dissected. A last type of simple migrations is furnished by the "perched villages." These are established on little valley flats at high altitude where the distance to the alp is inconsiderable.

COMPLEX MIGRATIONS

When the relief is varied but not too precipitous, complex migrations appear. The most widespread type is that in which a single temporary stage is established between the village and the mountain. In the lower part of the pastoral zone, sometimes even below, is the submountain, *montagnette*—the *Mayen* of Valais, *Maiensass* of the Austrian Alps, *Forsass* or *Voralm* of German Switzerland, known also in the Italian Alps under the names of *Casolare*, *Casina*, *Fourest*, *Stavolo*.

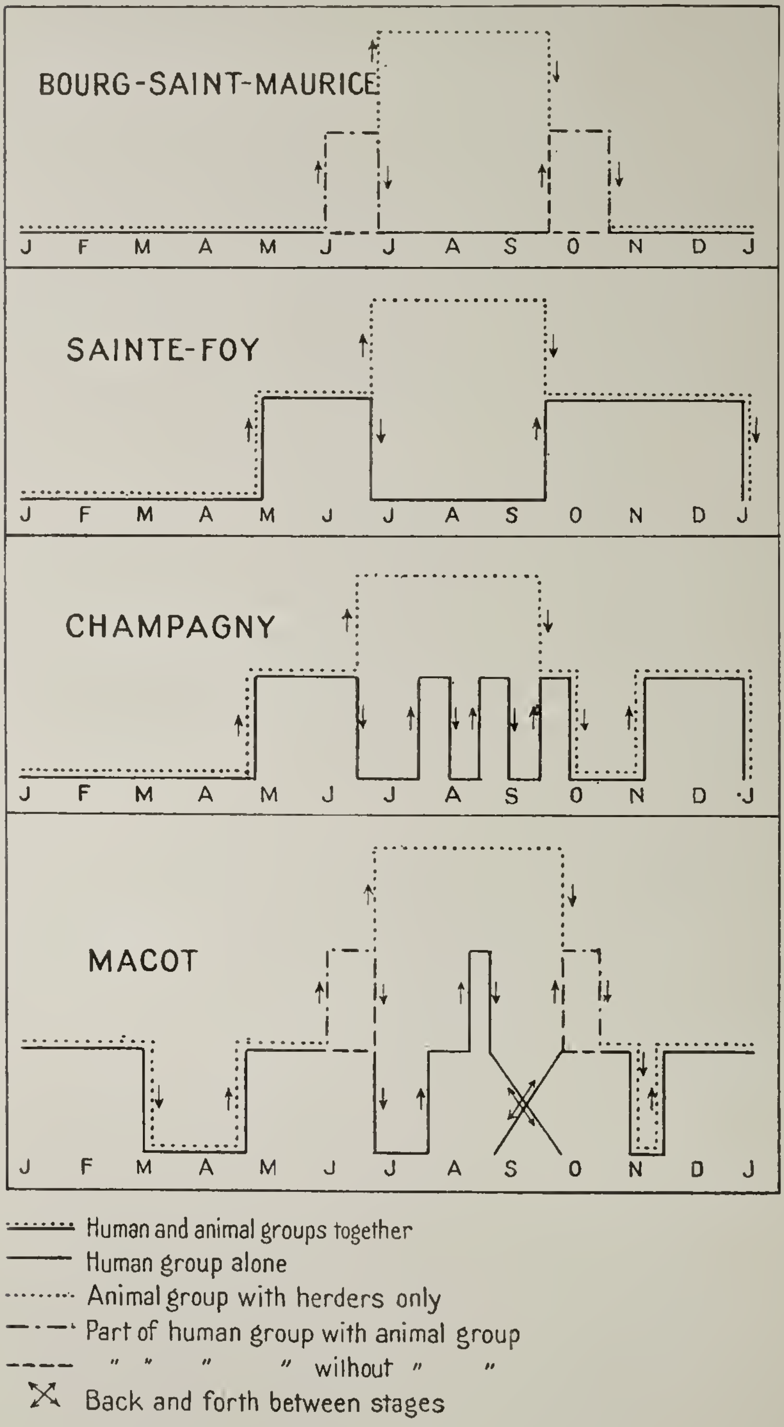
BOURG-SAINT-MAURICE
SAINTE-FOY
CHAMPAGNY
MACOT
J F M A M J J A S O N D J
Human and animal groups together
Human group alone
Animal group with herders only
Part of human group with animal group
" " " " without " "
Back and forth between stages

FIG. 1—Diagrams showing complexity of annual migrations in pastoral life of the mountains in the French Alps. All examples are from Tarentaise. The stages are: for Bourg-St. Maurice, village, pastoral *montagnette*, mountain; for Ste. Foy and Champagny, village, pastoral-agricultural *montagnette*, mountain; for Macot, village, *remue*, pastoral *montagnette*, mountain.

This type of complex migration is characteristic of the mature valleys of Middle Tarentaise and Middle Maurienne and is also seen in the secondary longitudinal valleys when they pertain to a single human group. In the large valleys with extensive slopes it is not rare that the vicissitudes of erosion have given rise to a series of flats: the lowest of these, in the trough of the valley, is occupied by the village, the higher form the submountain zone.

Types of life differ according as the submountain zone is pastoral or pastoral-agricultural. In the former case the animals, on their way to the mountains in spring, halt for two to four weeks; and, when they descend in autumn, they stay a little longer. A few members of each family are enough to care for the flocks. Thus during the intermediate season this zone is only occupied a short time and by a few people. In winter it is deserted; in summer it is visited by the mowers in a fashion, however, that should rather be considered an incursion than a sojourn. On the other hand, the village is occupied by men and animals together for about seven months and is thus the fundamental habitation.

It is otherwise when crops also are raised in the intermediate zone. The fields require more fertilizer than the meadows and more frequent and continuous care. In spring the entire family accompanies the flocks. They arrive at the intermediate zone at the end of April in time for sowing and tilling the fields. The animals leave for the mountain in the second half of June, and the work of the men is divided between submountain and village wherever agricultural work is pressing. Sometimes the village becomes the headquarters from which visits are made to higher fields; sometimes vice versa; sometimes they are occupied alternately. With autumn or late autumn men and animals meet again in the intermediate zone, where fields and meadows furnish both alike with sustenance. With winter comes the return to the village, often about Christmas, the journey being made through the snow. Thus the intermediate pastoral-agricultural zone marks a stage as important as that of the agricultural zone proper; there the village is occupied less than seven months; not infrequently it is reduced to being simply a winter refuge.

Matters are still further complicated when another temporary stage, the *remue*, is added to submountain and mountain. The *remue* is most often above the village, but it is not always easily distinguished from the submountain zone when this has fields also. It is, however, in the zone of regular cultivation and has a predominantly agricultural character. The *remue* duplicates the village houses.

This new complication arises under exceptional circumstances. An instance is afforded by the valley of Anniviers in the Swiss Alps.[33] Here the inhabitants have extended their domain of exploitation beyond their own high mountain valley to lands far down in the valley of the Rhone. The vast extent of their domain both horizontally and vertically determines their movements between four stages. The French Alps offer a similar example in Middle Tarentaise, exactly in the coal zone of the valley, which, thanks to the advanced stage of evolution, here forms a deep and wide basin with gentle slopes. There are superposed village and *remue* in the agricultural zone, submountain and mountain in the pastoral zone. Life is a perpetual migration. We shall illustrate with the particular case of Macot. (See Fig. 1.)

It is difficult to say which is the chief habitation of the people of Macot. Some of the folk have no less than four houses in the zones of villages and *remues*. However, the general rhythm of migrations can be described. From the end of autumn through the greater part of winter (from St. Martin, November 11, to the beginning of March) the population is in the *remues* above the foggy bottom of the valley. There, after being pastured on the aftermath, the animals are stabled. When March commences descent is made to the villages, where the stored forage is consumed and the men engage in preparation of the fields and vineyards. Return is made to the *remues* for a month or six weeks, from April 15–30 to May 20–30. Thence the family divides, some going to the *montagnette* with the herds, others to the villages or *remues*. All the men return about June 25 when the harvest season commences, provoking by the rapid succession of events at different stages urgent and complicated movements. From June 25 to July 10–20 hay and corn are harvested in the villages; from July 10–20 to July 30–August 10, at the *remues;* haymaking on the *montagnette* takes place about August 15–20. From mid-August to September 25, according to the particular need, each family establishes itself in village or *remue*, frequently making daily trips between them. The latter date marks the return of the flocks to the *montagnette*, bringing back again women and children. On October 15 the entire group, human and animal, is gathered together in the *remues* for a fortnight; then to the villages until November 11, when the cycle recommences. Thus, although they live in fixed habitations and not in tents, the people of Macot spend a truly nomadic existence—this in the twentieth century in the midst of a country of sedentary agricultural life.

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[33] Jean Brunhes and Paul Girardin: Les groupes d'habitations du Val d'Anniviers comme types d'établissements humains, *Ann. de Géogr.*, Vol. 15, 1906, pp. 329–352.

Decadence of the Pastoral Life of the Mountain

The pastoral life of the mountain, however, is in decadence in the French Alps as it is elsewhere in Europe. The causes are various. In this particular case they belong to two general orders of facts—depopulation and economic progress. The depopulation has assumed serious dimensions over large areas in the alpine regions and has greatly reduced the available labor—a result especially serious in the country of the "little mountains." On the other hand, stock no longer has to depend on the summer pasturage, increase of natural and cultivated meadows round the villages making it unnecessary to leave them. Pastoral life depends on the solidarity between the lower meadows and the alp, necessary complements the one of the other. Pastoral industry has entered on an intensive phase in respect of both sheep and cattle. The former has regard to the fattening of young lambs, which is more easily conducted on the farms than on the mountain; the latter is especially concerned with the utilization of milk either as butter or cheese. The establishments situated in the villages formerly functioned only in the winter. Now the tendency is to maintain a regular uninterrupted supply by limiting the summer exodus to the mountain.

Economic progress with the growth of urban life has worked havoc to the old pastoral life. Holiday resorts and tourist centers have been raised for at least a few months a year to the dignity of small, or even large, towns. Use of hydro-electric power has created seats of industry which have fixed a numerous permanent population. The consequences are twofold. Hotels, shops, and factories retain a part of the workers who formerly went to the mountains in the summer and thus aggravate the pastoral labor shortage.

Then tourists, holiday makers, and workers increase the demands on the dairy establishments.

It is difficult, however, to imagine that the riches of the pastoral zone will be altogether abandoned. In the French Alps as in other mountain countries stock raising remains the chief basis of human existence. In consequence it is likely long to preserve a distinctive characteristic which does not lack an archaic flavor.

FOG IN THE UNITED STATES

By Robert DeC. Ward
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Silent in its formation and disappearance, unaccompanied by violent atmospheric disturbances of any sort, associated with no brilliant optical phenomena, suggesting no startling world-wide human responses—fog nevertheless has many important relations to the life of man.

Ocean fogs delay voyages and lead to collisions and wrecks; when associated with ice, they involve supreme dangers to navigation and have resulted in disaster to many a well-found ship. On land, fogs shut out sunshine and retard railroad and other means of transportation; in large cities, especially when combined with soot and other impurities, they cause much added expense for artificial light and affect business activity along many lines. Doubtless also, in ways which are not yet definitely established, frequent and long-continued fogs have relations to human health as well as to human comfort.

Yet fogs are not without their advantages. Coast fogs on hot summer days may be welcome because of the screen which they provide against the sun's rays. The dampness, and even sometimes the very slight precipitation, associated with fogs may furnish much-needed moisture to vegetation.

In view of their many and varied relations to man, it is singular that fogs have received relatively little attention from students of the earth's atmosphere. Only here and there, and notably in the case of the fogs which are dangerous to navigation at sea, has this subject received the serious study which it deserves. As characteristic features of many of the world's climates, also, fogs merit careful consideration.

Geographical Distribution of Fog

The United States Weather Bureau recognizes two grades of fog. A fog which obscures objects at a distance of 1000 feet is recorded as *dense*. Other fogs are *light*. The geographical distribution of fog in the United States is shown on the accompanying map.[1]

The average numbers of days with dense fog are here shown, based on observations at regular Weather Bureau stations during the 20-year period 1895–1914. The two districts of maximum fog frequency are found along a considerable stretch of the Pacific coast and over the northernmost section of the Atlantic coast. An average of 40 days a year with dense fog occurs along the Pacific coast as far as southern California, while the same number of foggy days on the Atlantic is found only at the tip end of the northeastern coast of Maine. The west coast, with its prevailing onshore winds, is thus distinctly foggier than the east coast, where the winds are most of the time offshore. The Great Lakes evidently have no very marked effect in increasing the fogginess over their immediate shores. The effect, such as it is, seems to be somewhat greater in the case of the Upper Lakes.

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[1] Redrawn from Figure 82 in the "Atlas of American Agriculture," prepared under the supervision of O. E. Baker, Part II, Section A, U. S. Dept. of Agric., Washington, D. C., 1922. See also text, p. 44.

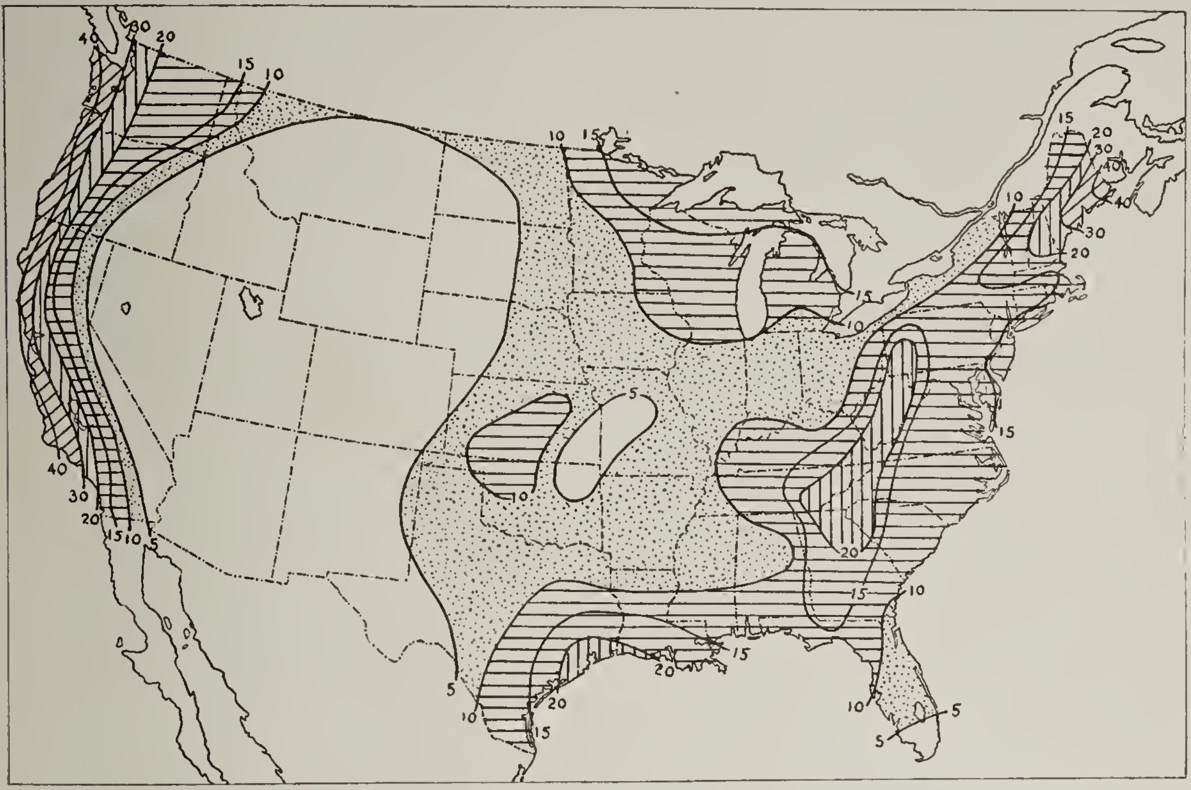

FIG. 1—Average number of days with dense fog in the United States. (From the Atlas of American Agriculture.)

The fog observations made at the usually rather widely separated stations of the Weather Bureau can hardly give an accurate picture of the distribution of the more or less local fogs that occur over the interior districts. A detailed map of fog distribution based upon the observations made by thousands of observers, located some in valleys and some on hills, some on lakes and some on dry plains, some in forested areas and some in the desert, would show a very "patchy" distribution, in which topography would be the main control. The facts shown on the accompanying map, however, give a reasonably accurate broad view, amply sufficient for purposes of a general climatic survey. Over the interior districts of the eastern portion of the country as a whole dense fog is relatively infrequent (less than ten days a year), the central and southern portions of the Appalachian Mountains having the maximum fogginess, which exceeds that of all but two very restricted areas on the Atlantic and Gulf coasts. These large figures for the Appalachian area doubtless represent local valley fogs. Over the arid or semi-arid western interior mountain and plateau districts there is a very large area with dense fog on fewer than five days annually.

Inland Fogs Due to Radiation

The fogs of the United States may be classified in two main groups, *inland* and *marine*.[2] The former may be further subdivided according to their origin. There are the fogs which are due chiefly to local radiation, probably usually combined with a slow air drainage. These are characteristic of clear, calm nights under weak barometric gradients. They are familiar phenomena in valleys, over and near rivers and ponds, and on lowlands as contrasted with neighboring slopes and hilltops. Hence they are generally known as valley and lowland fogs. These fogs are local. They usually begin to form towards or soon after sunset; "burn off" soon after sunrise, although occasionally lasting longer; and are most common and best developed during winter nights. They are, however, by no means limited to that season. Valley and lowland fogs of spring and autumn, as well as of summer, are very familiar nocturnal phenomena in hilly or mountainous districts. They are usually of relatively slight vertical extent, 100 to 200 feet being usual maxima of thickness. Such local radiation fogs occur all over the United States where weather conditions and topography are favorable, but they are least frequent in the more arid portions of the western plateau and mountain districts. In the California valley, fogs of this group are locally known as "tule" fogs because of their common occurrence over the low-lying swamps and bottom lands where Mexican bulrush (tule) grows. During the prevalence of tule fogs the surface flow of air is from the land to the sea, and the fog which has formed over the marshes is carried slowly seaward by this air movement. The California foothills region is mostly above this winter fog belt. Because of their usual occurrence over a comparatively restricted area, radiation fogs, although well and widely known, have not been adequately studied either in a large way or for individual districts. They may, however, be of considerable importance to man, especially in the matter of delays to transportation and the liability of accidents at such times. In a mountainous or a hilly country houses and villages situated along valley bottoms, on lowlands, or on the lower slopes of the hills are often enveloped in a thick fog during the evenings, nights, and early mornings, while people living at slightly greater elevations, on the near-by slopes or on the hilltops, are under clear skies at night and enjoy the early morning sunshine.

Inland Fogs Due to Cyclonic Conditions

There are also inland fogs that result from the chilling of warm, moist air as it passes over a snow-covered surface on its way northward towards a cyclonic depression drifting slowly eastward across the northern tier of states from the Great Lakes region to the Atlantic Ocean. Under such conditions a spell of thawing weather, very likely accompanied for part of the time by a warm rain, sets in, and the damp southerly air becomes foggy close to the ground. Fogs of this class are necessarily limited to the colder months. They are well known in the more northern sections of the eastern United States, often extending over considerable areas at one time, and may well be given the name of *cyclonic* fogs. They are usually not very dense. Cyclonic fogs also occur occasionally under somewhat different conditions, as when colder ocean air moves onshore or when, after a winter thaw, a cold westerly wind begins to blow on the rear of the passing depression. Both general and local conditions of fog formation vary, and it is not possible to have rules for classification too hard and fast.

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[2] For a general brief discussion of fogs in the United States see A. J. Henry: Climatology of the United States, *Bull. Q*, Washington, D. C., 1906, pp. 63–64, and H. C. Frankenfield: Fog Forecasting in the United States, *Proc. 2nd Pan Amer. Sci. Congr., Washington, U. S. A., Dec. 27, 1915, to Jan. 8, 1916*, Washington, D. C., 1917, Vol. 2, pp. 659–670.

Marine Fogs

Marine fogs, produced essentially by the mixture of air of different temperatures doubtless in many cases associated with a certain amount of eddy motion and by conduction, occur in three general districts: the Pacific coast, the coasts of the Atlantic and Gulf of Mexico, and the Great Lakes. Fogs of this group are really marine phenomena; but, as they often overlap the coasts, they must be considered in any discussion of the climatology of the United States.

Pacific Coast Fogs

Because of their frequency, their great latitudinal extent, and their peculiar importance in relation to navigation in a region where violent storms and high winds are rare, the fogs of the Pacific coast have been well studied.[3] A few years ago the Marine Exchange of the San Francisco Chamber of Commerce was asked what proportion of the shipwrecks along the California coast was due to fog. The answer was, "All of them."[4]

Marine fogs are a distinctive feature along the Pacific seaboard. At times they may extend along the entire coast from Puget Sound to southern California. Chiefly characteristic of the spring and summer months, they also occur in winter, but less frequently then. They have a much greater vertical thickness than the winter inland fogs, perhaps averaging 1500 feet but rarely exceeding 2000 feet. These fogs move in from the ocean, over which they extend for 50 miles or so offshore, with a westerly "sea breeze," arriving on the coast about or soon after sunset and disappearing in the early forenoon. They penetrate inland not more than a few miles. A fog which lasts through the whole day is a rarity in southern California.

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[3] See, e.g., A. G. McAdie: Fog Studies on Mount Tamalpais, *Monthly Weather Rev.*, Vol. 28, 1900, pp. 283–286, 492–493; Vol. 29, 1901, pp. 24–25, 61–63, 104–106; *idem:* Climatology of California, *Weather Bur. Bull. L*, Washington, D. C., 1903, pp. 239–249; *idem:* Fog and Frost in the San Gabriel Valley, *Monthly Weather Rev.*, Vol. 38, 1910, pp. 1895–1896; *idem:* The Clouds and Fogs of San Francisco, San Francisco, 1912 (note especially view opposite p. 56, "How the Fog Comes In at San Francisco"); A. H. Palmer: Fog Along the California Coast, *Monthly Weather Rev.*, Vol. 45, 1917, pp. 496–499; B. M. Varney: A Fog Phenomenon of San Francisco Bay, *ibid.*, Vol. 48, 1920, pp. 337–338; H. H. Wright: Fog in Relation to Wind Direction on Mount Tamalpais, Cal., *ibid.*, Vol. 44, 1916, pp. 342–344.

[4] A. H. Palmer, *loc. cit.*

Local conditions have much to do with the frequency, the duration, and the characteristics of these fogs. San Francisco, for example, is famous for its fog. Owing to the peculiar topography in the vicinity of that city, where the Golden Gate offers a free entrance for the ocean fog, from May to October "with clock-like regularity great banks of fog march in every afternoon and cover the brown hills" (McAdie). During these fogs the lapse rate (i. e. rate of change of temperature vertically) is negative. On Mt. Tamalpais, for instance, it is about three times as great as in the "no fog" condition. The excessive diurnal heating of the interior valley during the summer months causes a strong indraft of chilly ocean air from the coast. This wind, which blows with velocities of 25 to 30 miles an hour on summer afternoons at the Golden Gate, carries the fog inland, where it is either dissipated or rises to form "high fog." Above the surface wind blowing in from the ocean below there is an easterly offshore wind. These ocean fogs, with the chilly onshore winds that accompany them, have doubtless contributed not a little to the popularity, as residential cities, of Berkeley, Oakland, and other places to the west of San Francisco Bay, where there is less fog and less chilly wind. When these ocean fogs rise as they drift to and over the warmer land they become high fog or stratus clouds. At San Diego this high fog is known as the "velo" cloud. It is the common cloud of early morning and is much like the low cloud hanging most of the time off the western desert coast of South America.[5] Carpenter[6] speaks of the velo cloud as reaching its perfection over the littoral region of southern California and as being the chief characteristic of the summer in the San Diego Bay district (March–October). The sun usually breaks through this high fog about 10 A. M. on a normal summer day, the sky clearing shortly afterwards and remaining clear the rest of the day until about sunset. The velo is less than 1000 feet above the surface and never extends inland more than 60 to 70 miles from the coast.

In the opinion of the local meteorologists the marine fogs of the Pacific coast are chiefly the result of mixture. The warm, moist air moving towards the land from the ocean passes across the cold ocean current close to the shore, mixes with the colder air over that current, and is also itself chilled by conduction. It seems not to be the water vapor in the lowest levels which is condensed, but rather that of the higher levels. There is an interesting economic aspect of these summer fogs which has attracted some attention.[7]

The fogs are most prevalent in the dry season, when for weeks at a time no rain falls in southern California and herbaceous vegetation dries up. While the fog itself rarely gives any measurable precipitation, it certainly helps somewhat to relieve the excessive aridity. Occasionally as much as 0.05 inch of water has been deposited in one night, and smaller amounts (0.01 inch) are oftener recorded. The famous redwoods of California (*Sequoia sempervirens*) grow on a narrow coastal strip within the fog belt and nowhere extend inland more than 30 miles. W. G. Reed notes that on the Berkeley hills during summer fogs small trees drip with moisture and the ground beneath the trees is moist to a considerable depth. Away from the trees, on the other hand, the ground is dry and powdery, and the grass is brown. No practicable method has yet been devised by means of which any considerable amount of fog particles can be collected and used for the benefit of vegetation.

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[5] R. DeC. Ward: A Note on the South American Coastal Cloud, *Science*, Vol. 7 (N. S.), 1898, pp. 211–212; Isaiah Bowman: The Andes of Southern Peru, New York, 1916, pp. 143–145.

[6] F. A. Carpenter: The Climate and Weather of San Diego, Cal., San Diego, 1913, pp. 5–7, with a photograph of the velo cloud over San Diego Bay.

[7] See Cleveland Abbe: The Utilization of Fog, *Monthly Weather Rev.*, Vol. 26, 1898, p. 466; Vol. 27, 1899, p. 113; W. G. Reed: Fog as a Source of Water Supply, *ibid.*, Vol. 44, 1916, p. 288.

Atlantic and Gulf Coast Fogs

The Atlantic coast fogs differ from those of the Pacific in their irregularity and lesser frequency of occurrence. The only portion of the Atlantic coast which in any way equals the immediate Pacific coast in fogginess is in northern New England. On the basis of over thirty years' observations Petit Manan, Me., holds the record for the largest average annual number of days with dense fog on the Atlantic coast. From New England southward there is a decrease in the number of fogs until, at Key West, a dense fog is a rare occurrence. A glance at any table showing fog frequencies, as, for example, the observations collected and published by the United States Lighthouse Service, shows how greatly these frequencies vary even within short distances.[8] The location of a station with reference to near-by land and water areas, the surrounding topography, and the exposure to the wind are important controls of the amount of fog. Thus, certain islands, like Nantucket, and certain individual stations, like Cape May, N. J., have a good many more fogs than other places somewhat differently situated.[9] Occasionally but rarely, it may happen that a belt of fog extends more or less along the whole Atlantic coast from Maine as far as northern Florida. As a rule, however, the fog extends only part way down the coast, perhaps as far as Boston or New York or somewhat farther, and in most cases the fog belt is found only off the coast of Maine. On the New England coast fogs are most frequent in summer when the temperature-differences between water and land are most marked and when the warm southerly winds blowing over the cold ocean water near shore are well moisture-laden. Farther south the maximum fog frequency as a whole comes in winter and early spring. The frequent dense summer fogs on the New England coast are somewhat of a handicap to this locality as a summer resort.

Along the Gulf of Mexico marine fogs are not a significant element of climate except on the northeastern Texas coast. Their season is winter, and they vary considerably in number according to local controls, as is the case on the Atlantic coast. On the basis of several years' record Pensacola has more fog than Tampa, Mobile, or Corpus Christi. Galveston has about twice as many days with dense fog as the three stations last named.

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[8] See summaries of fog observations made at fog signal stations along the Atlantic coast in *Monthly Weather Rev.*, Vol. 44, 1916, pp. 21–22; Vol. 45, 1917, p. 499.

[9] F. W. Proctor: A Study of the Summer Fogs of Buzzards Bay, *Monthly Weather Rev.*, Vol. 31, 1903, pp. 467–472.

Fogs of the Great Lakes

A. J. Henry distinguishes two forms of fog on the Great Lakes.[10] One of these is a dense unbroken sheet or blanket which forms in spring and fall when a cyclonic depression moves slowly over the Lake region, bringing moist east and southeast winds. The other is a broken, low-lying form, with occasional patches of greater density separated by clear spaces. This is a summer, fair-weather type and is stated to be probably due to diurnal changes in temperature. The geographical and seasonal distribution of fog is somewhat complicated and varies a good deal on the different Lakes. According to Frankenfield there is not very much difference over the Upper Lakes between winter and early summer in the matter of fog, while on the Lower Lakes the maximum is in late winter and spring.[11] Over all the Lakes the least foggy season, in general, is late summer.

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[10] A. J. Henry, *loc. cit.* See also R. E. Pollock: Fog, on back of the *Meteorol. Chart of the Great Lakes* (U. S. Weather Bureau), June, 1911.

[11] H. C. Frankenfield, *loc. cit.* See also *Meteorological Charts of the Great Lakes*, published by the U. S. Weather Bureau from January, 1911, to September, 1913. On these charts the percentages of days with fog are shown for each lake during the navigation season.

POST-WAR ATLASES: A REVIEW

By W. L. G. Joerg

Popular imagination at the outset of the war conceived the geographer's task to be the locating of the places figuring in the operations and, ultimately, the drawing of maps showing the new boundary lines. The progress of the great conflict and especially its termination in the peace conference demonstrated even to the general public that geography is not a subject dealing merely with location. The atlases here under review[1] reflect this broader understanding. Although all of them are intended for general reference, several depart from the hitherto customary predominant attention paid to locational maps. The Times atlas presents the all-important element of relief with special prominence, while the Grande Atlante Geografico and Westermann's atlas emphasize economic geography. This is a development heartily to be welcomed.

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[1] The Times Survey Atlas of the World: A Comprehensive Series of New and Authentic Maps Reduced From the National Surveys of the World and the Special Surveys of Travellers and Explorers, With General Index of Over Two Hundred Thousand Names. Prepared at the "Edinburgh Geographical Institute" under the direction of J. G. Bartholomew. 112 plates. The Times, London, 1922. Prices vary according to bindings: loose-leaf, with index in separate volume, £10; half-leather, maps and index in one volume, £10; art canvas, one volume, or with index in separate volume, £6 6s; maps in portfolio, index separately, £4 15s. American price (only in half leather), 60. 18 x 12½ inches.

The Daily Telegraph Victory Atlas of the World: A Series of 150 Plates Containing Over 450 Maps and Diagrams Compiled from the Latest and Most Authentic Sources. Prepared under the direction of Alexander Gross. 150 plates. Published for The Daily Telegraph by Geographia, Ltd., London, [1922?]. Bound in cloth, £7 5s.; in half morocco, £8 15s.; full morocco, £10 10s. American price, $35. 20 x 13 inches.

Harmsworth's Atlas of the World and Pictorial Gazetteer, With an Atlas of the Great War. Containing 485 Coloured Maps and Plans, 3540 Photographic Views, and Index to 120,000 names. Edited by J. A. Hammerton. Body of atlas, 148 plates; war atlas, 31 plates. The Amalgamated Press, Ltd., London [1921?]. Bound in canvas, £3 5s.; in half leather, £4 12s 6d. 15 x 9½ inches.

Vivien de Saint-Martin et Schrader: Atlas universel de géographie, dressé sous la direction de F. Schrader d'après les sources originales et les documents les plus récents. Comprenant 80 cartes gravées sur cuivre et tirées en lithographie, avec un index alphabétique des noms contenus dans l'atlas. Nouvelle édition conforme aux traités de paix de 1919–1921. 80 plates. Librairie Hachette, Paris, [1922]. Bound in loose-leaf binding case with index, 325 francs. American price, $20. About 18 x 12 inches.

Stielers Hand-Atlas: 108 Karten in Kupferstich. Hundertjahr-Ausgabe [i. e. 10th edition], neubearbeitet von Professor Dr. H. Haack. 108 plates. Justus Perthas, Gotha. 1920 to date. Appearing in installments. Sixty-two plates have appeared to date, covering mainly the sections Central Europe, Southern and Western Europe, Eastern Europe, Asia, and the Polar Regions. The present review is of course based on these sheets only. International price, 51.30 Swiss francs; American price, $9.72, both exclusive of index, to appear when work is completed. 16 x 10 inches.

Andrees Allgemeiner Handatlas in 228 Haupt- und 198 Nebenkarten. Mit vollständigem alphabetischem Namenverzeichnis in besonderem Bande. Achte, neubearbeitete und vermehrte Auflage. Herausgegeben von Dr. Ernst Ambrosius. 132 plates, with additional maps on the back of 32 plates. Index in separate volume. Velhagen und Klasing, Bielefeld and Leipzig, 1922. International price, 80 Swiss francs; American price, $16, both including index volume. 18 x 12 inches.

Westermanns Weltatlas: 130 Haupt- und 117 Nebenkarten auf 106 Kartenblättern mit erläuterndem Text und einem alphabetischen Namenverzeichnis. Bearbeitet von Adolf Liebers unter Mitwirkung von R. Barmm, Professor Dr. P. Groebe, Dr. R. Müller, Dr. H. Winter, und anderer Sachkundiger. 3. unveränderte Auflage. 106 plates. Georg Westermann, Brunswick, 1922. Half leather: international price, 30 Swiss francs; American price, $6; full leather, 33 Swiss francs; $6.60. 9 x 10 inches.

Mario Baratta and Luigi Visintin: Grande atlante geografico: 102 tavole di geografia fisica, politica ed economica con 250 carte e cartine ed indice dei nomi. Edito sotto gli auspici del Ministero per l'Industria e Commercio e della Reale Società Geografica Italiana. 86 plates. Istituto Geografico De Agostini, Novara, 1922. 100 lire. International price, 100 French francs. 16 x 11½ inches.

This review will first take up separately each of the atlases under discussion and will endeavor to point out wherein each is distinctive. No attempt will be made at a systematic description of their contents, as they are all, except Westermann's atlas and the Grande Atlante Geografico, of the usual type of general reference atlases, i. e. they consist of maps, predominantly locational, of the countries of the world on as large a scale and with as many names as the size of the atlases will allow, with special emphasis on the country in which each is published and its colonies, together with a sprinkling of maps illustrating other phases of geography, such as climate, vegetation, economic resources, and human distribution. Although these atlases were selected for review because they are recent publications or new editions, they include the four leading general reference atlases extant, viz. Stieler, Andree, Universel, and Times, and to that extent this review may assume the character of a comparative discussion of reference atlases in general. After a digression relating to several recent distinctive atlases in which the locational element does not predominate, the consideration of the previous atlases will be resumed, and several general matters relating to them will be taken up, such as evidences of familiarity with current source material, the question as to which atlases to consult for the largest-scale and best maps of a given region, and the matter of general arrangement and physical make-up. In conclusion a suggestion will be made as to the best selection for libraries and other reference institutions.

THE TIMES ATLAS

It is in the representation of relief by the "layer" method of altitude tints (ranging usually from greens for the lowlands to browns for the highlands) that the Times atlas makes its distinctive contribution. The customary method, that of hachures or some similar device, expresses only relative relief but not absolute height. It shows where the mountain slopes are but does not show whether they rise from a lowland or a plateau. The layer method, on the other hand, does show absolute height. As the relief colors cover the whole area of the map, the layer method makes its possible to visualize the broad general distribution of highlands and lowlands at a glance. To familiarize the general public with this method and thereby acquaint them with this fundamental element in human distribution and activities is certainly to advance the cause of geography.

The selection of the contours shown has been made quite systematically. On the whole, the same contours are used for maps on the same scale. This is a valuable feature, making it possible easily to compare the relief of regions so represented, as the same color gamut holds for all. The unit of the basic contour interval, expressed in rounded-off numbers such as 100, 500, etc., is sometimes meters, sometimes feet, seemingly reflecting the unit employed on the respective source maps. But in either case the equivalents in the other units are given. As regards European countries in

1:1,000,000 the contours shown are 100, 200, 300, 400, 600, 800, 1000, 1500, etc., feet; for the maps in 1:2,000,000 the contours are 100, 300, 500, 1000, 1500, etc., feet. The Near East and India are shown in 1:4,000,000; here the contours are 500, 1000, 1500, 2000, 3000, etc., feet. For Africa in 1:5,000,000 the contours are 200, 500, 1000, 1500, 2000, 3000, etc., meters. For Canada, the United States, and Mexico, on the same scale as Africa, they are 100, 500, 1000, 2000, etc., feet. Both the map of all of South America in 1:10,000,000 and the more detailed map of central Argentina and Chile in 1:5,000,000 exceptionally have the same contours, viz. 600, 1500, 3000, 6000, etc., feet.

The style of contouring is not always fortunate. It is characterized by a certain angularity. The contours often lack the free and easy swing which, on such general maps as these, best reflect natural conditions. This defect is more noticeable on the larger-scale maps. The map of Switzerland (Pl. 35) may afford a clue as to its origin. The contours are here marked by small dots about two millimeters apart, which probably represent corresponding points that were set off by the engraver on the contours of the topographic maps on which Plate 35 is based. The fact that these points tend to be connected by straight lines is what gives the contours the aspect of angularity.

While the layer method of coloring gives an excellent synoptical view of the relief of a region, it fails to "catch" the inequalities of the surface that lie within the contour interval. If this interval be large, the method may fail to portray the relief features adequately. A comparison of the representation of the Sierra de la Ventana and the Sierra de Tandil in southern Buenos Aires province in the Times atlas (Pl. 101) with that in the Grande Atlante Geografico (Pl. 92), both on the same scale, will vividly bear out this statement. The method employed in the latter atlas is probably the ideal method of representing relief on general maps—by hachures combined with altitude tints. However, the difficult art of hachuring is not at the disposal of everyone; and it remains that, by popularizing the layer method, the Times atlas is performing a laudable educational service.

The title page says that the maps in the atlas are "reduced from the national surveys of the world and the special surveys of travellers and explorers." This would seem to imply that they are directly reduced from topographic sheets and route surveys. If this implication be correct, it seems an unnecessarily severe commitment as far as direct reduction from topographic sheets is concerned, inasmuch as it would involve the reduction of thousands of sheets to from one-tenth to one-fortieth their original size. For atlas maps it is sufficient, as a rule, to compile from reliable secondary sources for the topographically surveyed countries of the world (mainly western Europe, United States in part, and India; see Pl. 1 of the atlas); and of these areas even contoured maps on smaller scales usually exist. At all events an examination discloses that for the following localities, selected at random, the relevant topographic sheets were *not* used in compiling the maps in the Times atlas. The region east of Otsego Lake, New York (Pls. 86 and 93), is not based on the Cooperstown and Richfield Springs topographic sheets of the U. S. Geological Survey, nor is the region east and southeast of Granby in the Province of Quebec (Pl. 86) based on the Granby and Sutton sheets of the Canadian Department of Militia and Defence, nor the basin of the upper Nzoia River east of Mt. Elgon in Kenya Colony (Pl. 78, inset) on the Mumia's and Uasin Gishu sheets surveyed under the direction of the Director of Surveys, East Africa Protectorate.

Daily Telegraph Atlas

The Daily Telegraph atlas is a very creditable publication. Its maps are on unusually large scales for an atlas. They do not, however, necessarily show more than maps of the same regions in other atlases, the larger size being called for rather by the bolder manner of drawing, especially of the lettering. The maps are predominantly political, territorial divisions being distinguished by full areal coloring. Relief on the political maps is represented by hachuring in brown. While quite worthy, this hachuring is by no means—nor could it be expected to be—the equal of the hachuring in the German, French, and Italian atlases here discussed. There are physical maps of each of the continents and, in addition, of the world, the British Isles, certain districts of Great Britain (these on the scale of 4 miles to the inch, making them almost of topographical-map detail), the Sea of Marmara, Gallipoli Peninsula, India, the United States and Mexico, and New Zealand. On these relief is shown by layer tints without hachuring. The map of Russia in six sheets (Pls. 89–90 to 99–100), which is on the large scale of 1 : 2,825,000, seems to bear a close resemblance to the six-sheet map of Russia, 1 : 3,700,000, in the ninth edition of Stieler's atlas.

On looking over this atlas one cannot but feel regret that it has not been possible to expend so much laudable work on a more distinctive undertaking. However, the main *raison d'être* seems to be to provide a large reference atlas in English to sell at a relatively moderate price. This the Daily Telegraph Atlas seems to accomplish on the American market at $35.00 instead of $60.00 for the Times atlas.

Harmsworth's Atlas

Harmsworth's atlas is a popular atlas with pictures and text on the backs of the maps. The maps are printed from line cuts, which circumstance, as the preface points out, has made it possible to produce the atlas quickly despite the fact that the maps all appear here for the first time. Although lacking the soft appearance so characteristic of lithography, the line process is here quite adequate for the purpose. Unfortunately, the colors used are often somewhat garish; this, combined with occasional poor register, gives some maps a rather jumbled appearance. Of distinctive maps there are relatively few; these may be due to the influence of a geographer on the staff, B. C. Wallis as associate editor. They include a series of hypsometric maps with the layer tints on the land in rather pleasing browns and lavenders and the ocean tints in the customary blues (British Isles, Mediterranean and Baltic basins, the Alps, North and South America together) and two railroad maps distinguishing the systems by color (Great Britain and Argentina). The section of the atlas devoted to the war consists also of a series of layer-tint maps on which the changing positions of the battle front are shown in red. The geographer's touch is likewise evident in the three of the five introductory text articles that deal with "how men came to know the world," "how maps are made," and "how to make the most of an atlas." Less indicative of geographic method are a number of industrial maps throughout the atlas. They limit themselves to showing in red the names of resources and products over the localities in which they occur; only on the maps of western Europe, Australasia, and the United States is the distribution of mineral resources shown areally.

Although having the same name, the present atlas bears little resemblance to the Harmsworth atlas published about 1907, which was engraved by Messrs. George Philip and Son of London. The geographer will do well still to keep in mind this earlier atlas, because, besides its merely locational maps printed from stock plates, it contained a valuable and comprehensive series of real industrial and communications maps and a number of colored text maps illustrating commercial geography. Its hypsometrical maps and its large-scale map of the British railway systems were of superior execution and are not displaced by the maps in the present atlas.

ATLAS UNIVERSEL

The present Atlas Universel is the second edition of this work, which is the standard French general reference atlas. The appearance of the first edition, in installments, extended from 1881 to 1911, a circumstance which somewhat diminished its value because many of the early sheets had become superannuated before the last were issued. The present edition has appeared complete in three years (1920–1922). The great value of this atlas, as was dwelt upon in the review of the first edition in these pages,[2] lies in the fact that its maps are compiled from original sources. An extremely valuable list of these sources, with a critical discussion by the editor, M. Schrader, the veteran cartographer, accompanied the first edition. The present edition differs from the first, aside from being brought up to date in such matters as railroads and territorial changes, mainly in that the hachures used to represent relief are printed in brown instead of in the black of the first edition. This makes for much greater legibility, as the lettering and other black elements stand out from the mountain background. In the delicacy and yet firm handling of the relief hachuring this atlas excels. A good example of its effectiveness is afforded by the four-sheet map of the United States in 1:5,000,000 (Pls. 63–66), which, incidentally, is one of the best extant general representations of our country and which it is interesting to compare with the likewise excellent map of the United States on the same scale, also with relief in hachuring, in Andree's atlas (Pls. 200–201 to 206–207), mentioned below. To the American consultant it is a matter of regret that the sheet portraying the northeastern United States in 1:3,000,000 in the first edition has been omitted from the second. Fortunately its excellent representation of Appalachian relief has recently been preserved, in a reproduction from an engraver's proof before the names had been added, in Emmanuel de Margerie's monograph on the Jura Mountains.[3] A very valuable feature of the Atlas Universel, especially to geographers, is the series of physical maps of the continents (Europe, 1:10,000,000, Pl. 4; Asia, 1:25,000,000, Pl. 38; Africa, 1:20,000,000, Pl. 52; North America, 1:20,000,000, Pl. 59; South America, 1:20,000,000, Pl. 70) and of France (1:2,500,000, Pl. 7). On these land relief is represented by hachures and layer tints combined and ocean relief by bathymetric tints in blue. There is also a photographic reproduction of Chardon's excellent relief model of France.

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[2] *Bull. Amer. Geogr. Soc.*, Vol. 44, 1912, pp. 799–800.

STIELER'S ATLAS

The present tenth edition of Stieler's atlas, which many consider to be the best of all atlases, is not merely a revised reimpression of the ninth edition. Many new maps have been added, and many of the old maps have been rearranged. In the ninth and earlier editions a country or continent was generally the unit of representation, and this would be cut up into as many joining sheets as the format of the atlas required. In the present edition this system has been abandoned in a large number of cases; the sheet has been considered the unit and the region fitted into it. This plan has much to commend itself, as it avoids interruption of continuity. For example, in the ninth edition the Iberian Peninsula is shown on four sheets which are so disposed that the fourth shows practically only the Spanish province of Murcia and the Algerian coast opposite. The present edition contains the same map of the peninsula and on the same scale, but it is so divided that each sheet covers a convenient area, the necessary marginal areas being repeated from the adjoining sheets.

Also in the matter of scale the new edition contains an innovation. Germany was heretofore represented by a four-sheet map in 1:1,500,000—a smaller scale than that on which it was customary for most German atlases to depict their own country. (Indeed, this lack of undue emphasis on Germany was one of the facts which favored the internationalism of this atlas.) In the present edition nine sheets are devoted to Germany, and the scale chosen for them is 1:925,000. Besides these, nine other sheets on this scale have been introduced. The editor explains [4] that this was done because this scale is a multiple of 1 : 3,700,000, long used rather extensively throughout the atlas, and because this was the scale of the two-sheet map of the Alps. This decision seems rather unfortunate. It would seem as if the simple and increasingly widespread scale of 1 : 1,000,000 could have been used. Maps on this scale would have borne a simple ratio to the maps in 1 : 1,500,000, of which there are many in the atlas. The desire to bring the new scale into harmony with 1 : 3,700,000 would seem to be based on exaggerated grounds, as most of the smaller-scale maps in the atlas have long been in 1 : 7,500,000 —which just falls short of being one half of 1 : 3,700,000.

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[3] Emmanuel de Margerie: Le Jura, Première partie: Bibliographie sommaire du Jura français et suisse (orographie, tectonique et morphologie), *Mémoires pour Servir à l'Explication de la Carte Géologique Detaillée de la France*, Paris, 1922, Pl. 30 in separate pocket (see also text, pp. 580–586).

Another innovation is the use of blue throughout for drainage (rivers, swamps, etc.) and the coast line. This adds greatly to legibility. Only the great technical facilities of the publishers could have made possible another change—the separation of the heretofore black "culture" elements (railroads, roads, town symbols) from the black plate containing the names and their change from black to a dark gray. As this dark gray is hardly distinguishable from the black, this change seems an unnecessary luxury. A change that might have been more worth while would have been to differentiate more successfully between the symbols for roads and railroads. At present, being both in the same color and very similar in pattern, they are easily confused. The use of red for railroads, following the present practice of many standard atlases, would obviate this difficulty and give proper prominence to this more important of the two ways of communication.

The most important innovations, however, are connected with the further use of gray. Sea depths are shown on all the sheets so far published not only by submarine contours, as in the ninth edition, but also by bathymetric tints. For these, various shades of gray and blue-gray are used. Expanding a practice begun in the previous edition, gray is also used to emphasize the shaded side of mountains, these being shown in brown hachuring. To the present reviewer these uses of gray do not seem fortunate. Gray is a somber and uninviting color. The addition of bathymetric tints is indeed a valuable feature, but that shades of conventional blue are much more pleasing will immediately appear on turning to the maps in Andree's atlas. As concerns the relief features, the use of gray shading as here carried out amounts in some cases almost to a calamity and represents a distinct step backward in cartographical method. This holds true, for example, of the map of northern France and Belgium (Pl. 33), in which the exaggerated use of gray in this region of moderate relief to emphasize such features as the eastern scarps of the concentric cuestas of the Paris Basin gives the whole map a dirty, muddy appearance. Even in regions of high relief such as the French Alps (Pl. 31) and the Pyrenees (Pl. 25) this injudicious use of gray, by covering up, tends rather to suppress than to emphasize plasticity, especially where the plates have lost some of their original sharpness from reiterated use, such as Plate 25.

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[4] Hermann Haack: Die Hundertjahr-Ausgabe von Stielers Handatlas, *Petermanns Mitt.*, Vol. 67, 1921, pp. 19–22, vol. 69, 1923, pp. 7–16; reference in Vol. 67, p. 19.

It is this overburdening of the picture that is the gravest charge to be made against this otherwise truly great work. To maps filled with detail to begin with, more and ever more has been added, in a desperate attempt, as it were, to save the essential from the clutter of the unessential. We sincerely hope that in the next edition, already announced for twelve years hence, this policy will be abandoned. With the almost unlimited technical facilities of the Perthes establishment should go the compensating quality of restraint.

Andree's Atlas

That this complexity of detail and overcharging of the image is not necessarily due to a national trait is evidenced by another German atlas, Andree's. Its freedom from this fault makes many persons deem it the best atlas extant. Its cardinal virtue is clearness. Its admirable brown hachuring to show relief, with every stroke clean-cut; its firm treatment of rivers, bold enough to prevent these important guide lines of the map from being submerged in the mass of detail, and yet accurate; and the neat lettering and pleasing coloring all combine to create very attractive maps. If to this be added that they betoken throughout sound scholarship in their preparation, the reason for the esteem in which this atlas is held will become apparent. It has developed and improved consistently since its first edition in 1881, and with its fourth edition of 1899 it definitely entered the ranks of the four or five leading general atlases. The present eighth edition (1922) brings to fulfillment the promise of the transitional seventh edition (1921), which, as the first issued since the war, showed the boundary changes, although imperfectly. The present edition shows the new boundaries correctly in detail. While substantially the same as the last pre-war edition (sixth, 1914) it also differs from that edition by including a number of new maps, these maps being on larger scales than those previously employed in this atlas for these regions. The countries represented on the new maps are northern Sweden and Norway, 1:2,000,000; Finland, 1:2,000,000; Esthonia and Latvia, 1:1,000,000; and northern Russia, 1:4,000,000. Of maps which have appeared before, some are differently arranged to fit better the new territorial divisions; such as Poland and Lithuania in 1:2,000,000 and southern Russia in 1:4,000,000. There are also entirely new maps of Java, 1:3,000,000, and of central South America, 1:5,000,000—the latter a map of outstanding merit.

One of the valuable features of Andree's atlas is a number of admirable physical maps showing relief in hachuring and altitude tints combined. These comprise Europe, 1: 12,000,000; Central Europe, 1: 3,500,000 (with corresponding geological map on same scale); and Africa, 1:20,000,000. It is to be hoped that in future editions this excellent series may be extended to the other continents. Because of its distinctive style the new maps would nowise duplicate the already existing maps of these continents in the corresponding series in the Atlas Universel; rather the two series, completed, would afford an interesting comparison between two techniques, each admirable in its own way. The sheets in 1 : 1,000,000 devoted to France and the British Isles, to which reference will be made later, possibly are the best maps of these countries on that scale; certainly the map of France in this German atlas is more expressive than the map of France on the same scale in the Atlas Universel.

WESTERMANN'S ATLAS

Westermann's atlas is a distinctive contribution. It meets the needs of the new times. It combines in one an historical, a geographical, and an economic atlas. Each of these three sections is accompanied on the back of the maps by a succinct though comprehensive text containing diagrams and tables. The historical maps are of the customary type; the historical text is written from the German standpoint and, for recent times, tends to be chauvinistic. The geographical part of the atlas is by no means restricted to locational maps (these, although not as detailed as in the larger reference atlases, are sufficient.) There are also relief, vegetation, climatic, population density, and ethnographic maps.

But the most original part of the atlas lies in its economic maps. On some twenty maps is shown the mean annual pre-war value of the products of the leading economic countries and regions of the world. This is done by means of a rather ingenious device. Each product is indicated by a capital letter inscribed within a square whose area is proportional to the value of the product, one square millimeter connoting $1,000,000. (The capital letter used is the first letter in the German name for a given product; the rest of the word is printed in small letters.) Manufactures are indicated by a shaded band around the square and are colored according to the raw materials from which they are derived. The letters are printed in different colors and styles, each having its own meaning, as follows: orange, cereals; green, other plant products; red, animal products; blue, metals; black, other mineral resources. In addition the traffic of seaports is shown, the mean annual amount of registered tonnage being indicated by purple triangles whose area is based on the proportion of one square millimeter to 1,000,000 tons.

Described textually this scheme may seem somewhat confusing, but as carried out graphically it reveals at a glance the economic production of a region in a way that tables of statistics rarely do.

GRANDE ATLANTE GEOGRAFICO

Two of the atlases here discussed, the Times atlas and the Atlas Universel, were undertaken to emancipate their respective countries from the predominance of German cartography in this field—the latter as long ago as the period following the Franco-Prussian War. In 1917 a similar movement originated in Italy, sponsored by the enterprising Italian Touring Club. So far only a sample inset map from one sheet has appeared,[5] and it will be some time before the atlas is under way. Even so, it will be mainly locational in its scope. It is at this juncture that the Grande Atlante Geografico has just been published. It will fill the immediate need of Italians for an Italian atlas, but even when the Touring Club atlas appears it will not duplicate that work, because, as has already been said, its chief characteristic is its emphasis on physical and economic geography. The atlas consists essentially of two parts. First, there is a series of 21 world maps in 1:150,000,000 showing the distribution of plants, animals, and minerals of economic importance; in the case of such commodities as wheat, cotton, coal, the export and import routes are indicated, the width of line being proportional to the amount transported. Secondly—and these constitute the bulk of the atlas—there are physical maps of the various regions of the world, accompanied by economic maps of the corresponding region. These economic maps, which show food and mineral resources and agricultural and industrial areas, either directly face the corresponding physical maps or are so disposed that comparison is easy. The physical maps show relief in hachuring combined with green and brown altitude tints; political boundaries are shown in red (of the continents there is usually a political map with areal coloring facing the physical map), railroads by fine lines, red on some sheets, purple on others. In addition to the physical and economic maps there are the usual climatic, vegetation, and population density maps, mostly of the continents. The engraving of all the maps is of the very highest quality.

The atlas is therefore quite different from the usual general reference atlas; it resembles more a European school atlas. It is, however, more advanced: its physical maps are larger and contain more detail, its economic maps open up more thoroughly this important branch of geography. Taken all in all, the atlas strikes a happy mean between the general reference atlas as we have come to know it, mainly locational in its point of view and becoming increasingly overburdened with names, and the European school atlas, which breathes the real spirit of geography but has necessarily to confine itself to essentials. The publishers and editors are to be congratulated for their vision and their courage in thus introducing real geography to the general public.

Atlases Not Predominantly Locational

As regards atlases that are not predominantly locational in scope, a digression may here be permitted at least to call attention to several recently published. Outstanding among these is a systematic atlas[6] by the

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[5] Accompanying L. V. Bertarelli: L'attività geografica del T. C. I. nel decennio 1910–1920; Il "Grande Atlante Internazionale del T. C. I." (Nota per l'VIII Congresso Geografico Italiano, Firenze, 1921), 32 pp., Milan, 1921.

[6] Atlante di geografia fisica, politica ed economica: Fascicolo I, 18 plates, G. B. Paravia, Turin, 1918.

Italian geographer, Professor Assunto Mori, in which the various geographical elements, such as relief, climate, human distribution, economic conditions, are represented both as general phenomena and in their application to the different regions of the world. The volume so far published covers general geography and western and southern Europe. Under general geography one plate, consisting of about twenty to twenty-five small maps, is devoted to each of the following ten groups of subjects: astronomical geography, cartography, distribution of land and water and their relief, geology and geomorphology, hydrography and terrestrial magnetism, climate, economic products, human geography, political geography, history of discovery and exploration. Under regional geography two plates are devoted each to Europe as a whole and to Italy and one plate each to the Iberian Peninsula, France, and the British Isles. In the regional series there is a central larger-scale political and communications map of the country, surrounded by smaller-scale maps showing relief, climate, density of population, agricultural products, mineral and industrial products, colonial possessions, and typical cities, and besides, in some cases, geology, languages, religion, and amount of traffic.

A somewhat similar publication is a systematic atlas,[7] by Professor Max Friederichsen of the University of Königsberg, illustrating the regional geography of Europe. Two installments have appeared, dealing with Eastern Europe, the lands around the Baltic, the lands around the North Sea, and France. A third installment, on the Iberian Peninsula and Italy, was announced for publication in 1920. Of each region there are three series of about eight small maps. The first series takes up "the elements necessary to arrive at a division into natural regions (geology, morphology and structure, relief, climate, vegetation)", the second deals in detail with climate, and the third with human geography (territorial development, present and past ethnography, population density, economic resources, means of communication).

Among recent atlases of the usual school-atlas type, but of advanced grade, there are especially worthy of mention two British[8] and one Italian.[9] Advance pages of the first American atlas[10] of this type have recently appeared.

USE OF CURRENT SOURCE MATERIAL IN THE GENERAL REFERENCE ATLASES

Returning now to the larger reference atlases, it may be helpful to discuss in this way, rather than under each atlas, several general matters relating to them.

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[7] Max Friederichsen: Methodischer Atlas zur Länderkunde von Europa. 1. Lieferung: Ost-Europa und die Ostseeländer, 6 plates, 1914; 2. Lieferung: Die Nordseeländer und Frankreich, 6 plates, 1915; 3. Lieferung: Die iberische und italienische Halbinseln, 1920 (?), Hahnsche Buchhandlung, Hanover and Leipzig.

[8] J. G. Bartholomew: The Advanced Atlas of Physical and Political Geography, 71 plates, Oxford University Press, London, 1917. George Philip: Philips' Senior School Atlas, 61 plates, Geo. Philip and Son, London, 1921.

[9] Luigi Visintin: Atlante geografico metodico, 63 plates, Istituto Geografico De Agostini, Novara, 1921.

[10] J. Paul Goode: School Atlas, Physical, Political, and Economic. For American Schools and Colleges. Advance pages. 24 plates. Rand, McNally & Co., Chicago and New York, 1922.

When it is remembered that a general atlas has to portray the whole world, and that on relatively large scales, any undue criticism of errors that may occur will be avoided. What should be required of the compilers of such a work is a knowledge of the leading map sources for all parts of the world and a critical sense. Given this proper equipment, whatever errors occur are then not errors of principle but only the normal ones of human frailty; and it is solely from this point of view that any will be mentioned shortly. The firms engraving the Times, Universel, Stieler, and Andree atlases and the Grande Atlante Geografico each fully meet the standard just outlined; each has a staff of trained cartographers and maintains a map collection which is kept up to date by means of current geographical periodicals and otherwise. Evidence of this competence is furnished, for example, by the map of China in Stieler's atlas (Pl. 74), on which the series of compressed mountain ranges between the two great elbows of the Brahmaputra and the Yangtze Kiang are shown according to the many recent explorations in this region; by the map of Arabia in the same atlas (Pl. 66), on which Philby's explorations in 1917 in the southern Nejd are already entered, thus affording the first picture in its proper setting of the Jebel Tuwaik, that major relief feature of central Arabia; by the map of Libya in the Grande Atlante Geografico (Pl. 71–72), on which the results of Tilho's work are incorporated, thus likewise for the first time showing the northeastward extension of Tibesti, which he established, in its relation to the rest of the upland as revealed over forty years ago by Nachtigal's map in his "Sahara und Sudan;" and, finally, by the maps of Canada and northeastern Canada in the Times atlas (Pls. 82 and 83) on which are shown, in Hudson Bay, the Belcher Islands in their true outlines as first published in this *Review* (Vol. 5, Pl. 4) and as since incorporated on official maps of Canada, especially that published by the Department of Interior on the scale of 1:2,217,600. Possibly because these sheets had already been engraved the Belcher Islands are not correctly shown on the maps of North America (Pl. 80) and of the North Atlantic Ocean (Pl. 8) in the same atlas, although they are so large that they cannot but be distinguished even on the scales used for small maps of North America. They are also shown on the relevant sheets in Andree's atlas but not in the Atlas Universel and the Grande Atlante Geografico. The new islands discovered by Stefansson in the North American Arctic Archipelago north and east of Prince Patrick Island are shown in their preliminary outlines, as published in this *Review*, in the Times, Daily Telegraph, Harmsworth (only on the map of North America, pp. 384–385), and Andree atlases and the Atlas Universel (only on the map of the Polar Regions, Pl. 80); they are shown in their correct final outlines, as published in 1921 in Stefansson's "The Friendly Arctic," on the map of the Arctic in Stieler's atlas (Pl. 3) and in the Grande Atlante Geografico on the map of Canada (Pl. 78) but not on other maps in this atlas where they should appear.

Several minor errors may be mentioned. In the Atlas Universel, Indian

Territory persists on the maps of the United States; among Western transcontinental railroads are omitted the Chicago, Milwaukee, and Puget Sound, the Western Pacific, and the southern part of the Salt Lake, San Pedro, and Los Angeles; Lake Maracaibo is shown in the incorrect outline which goes back to Codazzi, 1840, and which has been superseded by the work of the Comisión del Mapa Físico y Político de Venezuela, available since 1907. Stieler's atlas, while showing all the new international boundaries in Europe (and, like all current German maps, also the old boundaries of Germany) does not always properly indicate or name the internal subdivisions. Thus, in Alsace-Lorraine the German subdivision into Upper and Lower Alsace and Lorraine is shown and not the present French *départements* of Haut Rhin, Bas Rhin, and Moselle. Also, the names in Czechoslovakia, Poland, and Jugoslavia have not always been given their present official form. (However, a note on the map of Slovakia says that the Czechoslovak versions will be listed in the index, although the Hungarian forms had to be retained on the map.) While this inertia is understandable, scientific objectivity and memories of the international prestige of the former editions might, it would seem, have made it possible to overcome it.

The Largest-Scale Representations of Given Regions

As the same region is represented on different scales in different atlases it may be of interest to point out in which of the atlases here discussed a given region is represented on the largest scale. The largest-scale map is not necessarily the best, of course, nor even the one containing the most detail. It may be drawn more boldly or with larger lettering. Such, for instance, is the case, as has already been said, with the maps in the Daily Telegraph atlas, and therefore their often being on unusually large scales does not necessarily entitle them to be enumerated here. The United States is represented in 1 : 5,000,000 in the Times, Andree, and Universel atlases. Because of its clearness, together with is excellent relief in hachures, the Andree map, to which attention has already been called, is possibly the best general map of the United States extant, with that in the Atlas Universel a close second. The map in Stieler, although in 1 : 3,700,000, is badly out of date. The British Empire is naturally dealt with especially well in the Times atlas. Canada as a whole is shown in 1 : 5,000,000, and the provinces in 1 : 2,500,000. Of the Union of South Africa there is a large two-sheet map in 1 : 2,500,000. India is covered in 1 : 4,000,000. South-eastern Australia and New Zealand are shown in 1 : 2,500,000. These scales are unusually large; most other standard atlases do not exceed 1 : 5,000,000 to 1 : 10,000,000 for these areas. Stieler's atlas was a notable exception as regards Australia; its map of the whole continent in the ninth edition was in 1 : 5,000,000 (even in the Times atlas the uniform-scale maps of all of Australia are in 1 : 6,000,000); in the current, tenth, edition, the scale has been reduced to 1 : 8,000,000. Of certain European countries the best or largest-scale maps, as the case may be, occur in the French and German atlases. A series of maps in Andree's atlas in 1: 1,000,000 that includes the British Isles, France, northern Italy, Esthonia and Latvia and western Jugoslavia can hardly be surpassed. Although on the scale of the International Map of the World, they in no way duplicate that publication. Relief, being in hachuring, is more expressive than on the International Map, whose contour interval is too large to "catch" all of the inequalities, especially in lowland regions. As railroads are in red, these maps make convenient travel maps. There are excellent new 1: 1,500,000 maps of Poland and the Baltic States in Stieler's atlas; these are probably compiled from the 1: 100,000 topographic map of these countries, representing an extension of the topographic map of Germany, which had been prepared by the German War Office before the war and which has only since become public property. Russia is represented in 1: 3,700,000 in Stieler's atlas. Of Algeria and Tunis there are excellent maps, on the same scale, 1: 2,500,000, in Andree's atlas and the Atlas Universel; the best atlas map of Morocco is in the latter, scale 1: 2,500,000. The former German colonies are represented in 1: 2,000,000 in Andree's atlas (except western East Africa, which is in 1: 4,000,000). The largest-scale map of all of Africa is in the Times atlas; it is in 1: 5,000,000. Distinctive maps of Asiatic countries are the following: Asiatic Russia (rarely represented by a map of its own in non-Russian general atlases), 1: 15,000,000, in Andree's atlas (the corresponding maps in the Universel and Times atlases are not as good); western Siberia, 1: 7,500,000, in Stieler's atlas; Japan, 1: 3,000,000, in Andree's atlas. The largest-scale atlas map of South America, and certainly the best while under the continued revision of its able compiler, the late Victor Huot, is the six-sheet 1: 6,000,000 map in the Atlas Universel. The new map, referred to above, of central South America in 1: 5,000,000 in Andree's atlas is now, because of its relatively large scale and its excellent execution, possibly the best general map of that important area. The large scale, for physical maps, and the fact that relief is shown in the ideal manner by a combination of hachures and altitude tints, make the maps of South America in the Grande Atlante Geografico (the whole continent in 1: 10,000,000; northeastern Argentina and southern Brazil in 1: 5,000,000) especially valuable.

Arrangement and Physical Make-Up

Although minor matters, a few words as to the arrangement and physical make-up of the reference atlases under review may not be out of place.

Each atlas contains an index listing the names that occur on its maps and indicating their location. In the case of one atlas, Andree, the body of the atlas has become so bulky that the index is published only as a separate volume. In the loose-leaf binding of the Times atlas the index is also issued separately. All the atlases, with one exception, locate names by referring to the "square degree" or other grid unit on a given map, these units being defined generally by letters on the upper and numbers on the side margin of the map. Unfortunately the Times atlas has chosen to depart from this established and practical scheme. It does refer to grid units, but not directly, as their designations are not printed on the maps themselves but on a transparent "indexing frame." To locate a name this transparent frame has first to be placed on the map in question, and the place sought then found under the transparency in the square indicated in the index. This indirect and impractical method, rendered more so by the risk of loss of the loose transparent sheet, especially in libraries, is not wholly overcome by the fact that all places are also located in the index by their latitude and longitude.

A helpful practice, the printing of an index map on the back of each plate to show the location of that area and of the areas shown on other plates in the same general region, which was followed in the previous edition of Stieler's atlas, has been abandoned in the present; it is fortunately perpetuated, however, in the Times atlas.

As to make-up, Stieler's atlas is the handiest of the four leading reference atlases. It is only 10 by 16 inches in size, and, with the index in the same volume, weighs (the ninth edition) only ten pounds. (Among atlases of secondary importance, Harmsworth's atlas is about the same size and weight as Stieler's atlas; Westermann's atlas is very handy in size.) The Times, Andree (even without index), Universel, and Daily Telegraph atlases have almost reached the limit of practicability. The Times atlas, for example, measures 18 by 12½ inches and, in the one-volume binding, weighs seventeen pounds.

Choice of Atlases for a Library

The question is often asked, Which atlas or atlases should a library have? We may answer: The general library that can afford but one atlas, and that can afford the price, can do no better than to purchase the Times atlas. Up to its recent publication there was no really adequate general atlas in English; we are fortunate in now having in it a work that corresponds to that description. However, if the $60 price be an obstacle, the Daily Telegraph atlas may be substituted, or, if the language barrier can be waived, one of the German or French atlases. A library that can afford two atlases should add to the Times or Daily Telegraph atlas either Stieler, Andree, or the Atlas Universel. A reference or university library should have the Times, Stieler, Universel atlases and the Grande Atlante Geografico, or the same group with Andree's atlas substituted for Stieler. If any of these institutions have on their shelves, among older general atlases, any of the following, they should not discard them, as, beyond such changeable elements as political boundaries, they deal with geographical matters of permanent value: Atlas Général Vidal-Lablache, Paris, 1909 (1921 edition with new boundaries, otherwise unchanged); Atlas de Géographie Moderne, by F. Schrader, F. Prudent, and E. Anthoine, Paris, 1908; Spamer's Grosser Handatlas, edited by A. Hettner, Leipzig, 1897 (a German version of an earlier edition of the preceding); Neuer Handatlas, by E. Debes, 4th edition, Leipzig, 1913. It will be noticed that no American atlas is mentioned in this list, and indeed there is none to compare with the works mentioned in this review. The most satisfactory still is the Century Atlas, forming part of the Century Dictionary, in which the individual states of the United States are of course shown on larger scales than in any European atlas. Since Scribner's Statistical Atlas of the United States (New York, 1883), which reflected Henry Gannett's spirit and deals only with our country, we have had no noteworthy American atlas outside of government publications, and even that atlas is, in a way, a private-firm version of the Tenth Census Atlas.

THE SHAPING OF THE EARTH'S SURFACE: A REVIEW

By W. M. Davis

Passarge's comprehensive work "Die Grundlagen der Landschaftskunde"* deserves attention because of the author's experience as a field observer and a university teacher, as well as because of the industry with which its several volumes have been prepared and because of the novelty of the ideas and methods therein presented. The first volume, as has already been told in these pages,[1] is limited to a purely empirical description of various land forms, all explanatory considerations concerning them being postponed until the third volume is reached. The second volume, dealing with the atmosphere and the ocean and with plants and animals in the landscape, is not particularly considered here, except to say that in certain chapters its method departs strikingly from that of the first volume by giving explanation to various phenomena in immediate association with their description.[2] The third volume here to be reviewed has for its object the rational or explanatory treatment of land forms. Various types of crustal structures are described, and their forms, both unmodified and modified by erosion, are briefly set forth in Part I (pp. 1–95); various sculpturing agencies and the resulting surface forms are elaborately discussed in Part II (pp. 96–467); and a genetic classification of land forms constitutes Part III (pp. 468–522). On account of this plan of treatment the connection between the explanations in Volume 3 and the empirical descriptions in Volume 1 is not easily made. Some outline figures are repeated in the third from the first, but there are practically no cross references from one volume to the other, and the order of treatment in the third is very different from that in the first. Not only so; the various structures described in Part I of Volume 3 are not taken up again *seriatim* in Part II and followed systematically through the changes wrought upon them by erosional processes.

Structures and Forces

Certain types of structure for which a systematic treatment is evidently intended are nevertheless unsystematically treated in Part I. For example, diagrams of faults sometimes show their initial displacement of the surface and sometimes show the displacement truncated as if by perfect planation although neither the initial nor the ultimate form of a faulted structure is often encountered in actual landscapes; the more commonly occurring intermediate or sequential forms are not represented; and the text takes no account of the differences in the diagrams. Flexed structures are illustrated by Powell's diagram of the plateaus of northern Arizona, but the text does not make it clear that the flexed masses are now well advanced in a second cycle of erosion after their peneplanation in a first. In a certain passage it is briefly stated: "Composite faults produce steps. The double step of Kilimatinde in east Africa is perhaps such a composite fault" (p. 15); but the actual features of this and other examples are not described.

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* Siegfried Passarge: Die Grundlagen der Landschaftskunde . . . , Band III, Die Oberflächengestaltung der Erde. xxix and 558 pp.; diagrs., ills., bibliogr., index. L. Friederichsen & Co., Hamburg, 1920.

[1] W. M. Davis: Passarge's Principles of Landscape Description, *Geogr. Rev.*, Vol. 8, 1919, pp. 266–273.

[2] A number of the explanations concerning the atmosphere are unsatisfactory, not to say incorrect. The cause of land and sea breezes is imperfectly presented; the account of the deflection of winds by the earth's rotation is erroneous; the strength of the prevailing westerlies is improperly ascribed to poleward crowding; the diagram of a tropical cyclone makes the winds close to the center almost radial instead of almost circular; the cause of clouds is said to be the ascent of warm and moist air currents into the cold upper regions ("in kalte Höhen"); and the cause of rain is similarly explained a few pages later: the adiabatic cooling of ascending air currents is not mentioned in this connection. As to the ocean, spring and neap tides are described as extra high and extra low instead of as having strong and weak range; surf is wrongly ascribed to wave retardation by bottom friction.

After various structures are set forth the forces that produced them are stated, and the causes of the forces are then explained: but such a procedure is unnecessarily extended for the geographical study of the visible landscape. This tendency to over-learned treatment reaches a climax of irrelevant erudition in a six-page exposition of Wegener's hypothesis of continental flotation. Surely a student of land forms would be more benefited if the space thus occupied had been utilized with more pertinent considerations. For example, under coastal plains the transformation of initial forms into sequential forms ought to be more fully accounted for: the text merely announces in five lines that a sea floor (the strata on which are given an impossible arrangement in Figure 23–1), after emerging as a gently inclined plain, will be degraded in such a manner that the resistant strata will survive in cuestas while the weaker strata are worn down in longitudinal (subsequent) lowlands (p. 19); but neither the text nor the block diagram of this composite erosional form, Figure 23–2, gives any attention to the transverse (consequent) water gaps through the cuestas in relation to which the longitudinal valleys are excavated. Similarly, the concentric ridges of a denuded quaquaversal anticline and of a similar syncline are represented in Figure 25 without any transverse notches by which the concentric (subsequent) valleys are drained.

Erosional Processes

The greater part of the book is devoted to the operation of various erosional processes in their work of carving the earth's surface; and here the originality of the author is shown both to his credit and otherwise. Greatly to his credit are the really excellent chapters (pp. 132–173 and pp. 173–206) on the formation and movement of soils and on the resulting land forms as affected by differences of climate. No other textbook brings together so large a variety of information on these subjects. Distinction is profitably made between the soils of polar deserts, tundras, humid temperate zones, deserts, and the equatorial rain belt. There can be no question that the attention of geographers should be directed to the variation of these minor features under different climatic conditions; yet it often seems as if more consideration were here given to form-producing processes than to process-produced forms; and, moreover, as these detailed chapters on soils are introduced earlier than the more general chapter on the sculpturing of land surfaces under the leadership of streams, the soil forms are insufficiently related to their physiographic environment and are almost wholly divorced from the various stages of the cycle of erosion in which they belong. That is unfortunate. More unfortunate still is the denial that soil creep is an effective process of degradation on forested slopes; and as a result of this denial the peneplanation of temperate forested regions is ascribed on a later page to the more effective degradational processes of a tundra or an arid climate, which are without further evidence assumed to have formerly operated in forested peneplains. It is doubtful whether American observers of the Appalachian piedmont belt will accept this conclusion.

Passarge's Attitude towards Deductive Method

Perhaps the most explicitly expressed intention of the book is found at the opening of Part II, where it is declared that type forms ought to be established by the inductive method; that is they must be based upon the observation of actual forms and of the processes working upon them. The curious feature of this declaration is that it is offered as a correction of the method of those geographers who avowedly employ deduction as an aid in the establishment of type forms, as if such geographers did not, quite as much as Passarge, utilize actual forms and the processes working upon them as the basis of generalizations from which all their deductions afterward proceed. The condemnation of deduction is, indeed, so severe that one might expect its use to be excluded from the book; yet, as a manifest matter of fact, it is employed over and over again and sometimes avowedly. Of course it is employed, for hardly a step can be made in the explanatory treatment of land forms, which is whole-heartedly adopted, without making deductive inferences that go far beyond inductions. Instead of accomplishing the announced intention of establishing type forms inductively, the intention seems to have been forgotten soon after it is expressed, for deduction is thereafter used freely even if sometimes unconsciously.

In spite of the avowed preference for induction, the early pages of Part II depart from that rather prosaic method of presentation by setting forth a somewhat elaborate classification of land forms in which deduction enters repeatedly. For example, forms produced under present climatic conditions are called "Jetztzeitformen," while those produced under past conditions are called "Vorzeitformen;"[3] and this discrimination evidently involves deduction. Furthermore, the early introduction of the elaborate classification here proposed, before the things classed are adequately described or explained, is not inductive and reasonable but arbitrary and dictatorial and as such must tend to dull the employment of real induction by the student.

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[3] In Passarge's "Physiologische Morphologie" (*Mitt. Geogr. Gesell. in Hamburg*, Vol. 26, 1912, pp. 133-337) these forms were called "harmonisch" and "disharmonisch." Similarly, rivers and their valleys in a region of moist climate are contrasted with rivers and the valleys that they erode when flowing from a region of moist climate into a desert, like the Nile in Egypt: these were formerly named "konsonant" and "dissonant" forms and are now called "Heimatsformen" and "Fremdlingsformen."

When it comes to describing typical forms, erosional process and not underground structure is taken as the guide. It is easy to defend this method logically if certain premises are assumed, but it is questionable whether the method will lead students to give their attention sufficiently to the forms—the carved structures—that they observe instead of to the carving of the structures. True, an association of form and structure is to be found in Part I; but, as above noted, it is there treated so incompletely that no student can acquire from it a clear comprehension of the flowing change of form that results from the working of erosional processes on structural masses; and without that comprehension the explanatory treatment of land forms must remain unsuccessful.

Some Incorrect Deductions

It is perhaps because of the author's dislike for deduction that he sometimes employs that indispensable mental process incorrectly. The most striking illustration of this kind is in connection with subsequent valleys. A plain truncating a series of vertical hard and soft strata is arbitrarily assumed to exist, without explanation of its origin; then, the previous development of streams along the weak strata being tacitly excluded, one reads: "It may easily happen that the stream bed will be incised in the weak strata, and it will thereafter oscillate as between walls where the hard strata prevent lateral excavation" (p. 256). Thus the ordinary case of subsequent streams developed in one cycle which reaches peneplanation and continued in their adjusted courses after uplift introduces a second cycle, is overlooked, and a very arbitrary case is given in its place.

Even more seriously wrong is the treatment of a truncated mass of strong and weak inclined strata, base-leveled and unconformably overlain by a cover of nearly horizontal beds on which several consequent streams take their courses at right angles to the strike of the buried strata. The streams soon cut down to the buried strata on which they are thus superposed; and in due time, after the covering beds have been all worn away and the underlying weak strata degraded, the superposed streams cross the strong rock ridges in narrow gaps. The explanation then proceeds as follows: "The rain water [coming from the degraded lowland upstream from a ridge] is obstructed by the ridge and turns to one side; thus a stream channel is developed along the ridge base on its upstream side, and the small streams, indeed perhaps even the main streams, will be deflected by this channel. Thus originate ridge-border rivers, flowing at right angles to the original slope [of the vanished covering beds] while on the other side of the ridge lie the beheaded streams, heading at a notch in the ridge" (p. 267).

That explanation is fundamentally wrong. It assumes that subsequent streams work aggressively, as a plow cuts a furrow, instead of retrogressively, as a spade cuts a ditch. The deflection of superposed transverse rivers never results from their active running against an obstacle and turning aside from it; they are passively deflected as a result of headward erosion by subsequent branches of other rivers; and it is always the subsequent branches that grow out from a deeply incised, transverse master river which undercut and divert the less deeply incised, minor transverse rivers. The block diagrams by which stream deflection is here illustrated are no better than the text. In one of them the weak strata are reduced to absolute plains, up and down stream from the strong-rock ridge, although deflection is never so long delayed as that.

Another erroneous interpretation is made regarding watercourses in certain tropical regions like South Africa, with which Passarge is familiar, where a dry season of low-water streams alternates with a wet season of occasional heavy floods. It should be here remembered that a perfectly natural consequence of this seasonal alternation is that the large and deep *channels* of the main rivers, which are filled to overflowing at times of flood after extra-heavy rains, look like *valleys* in the dry season when they are followed only by diminished low-water streams trickling along the channel beds; and also that in the dry season the perfectly normal discordance of depth between small side-stream channels and the large main-stream channel is so plainly visible that the side-stream channels have the appearance of hanging valleys. Now, although Passarge's text at one point correctly states that the bed of a side-stream channel is not so deep as that of a main-stream channel and that at times of high water the surfaces of the two streams join at the same level, the next following passage, as well as the legends of the accompanying schematic illustrations, Figures 137 and 138, speak of the channels as "valleys," and a side channel is actually called a "hanging valley."

GLACIAL EROSION

An unfortunate sequel to this misuse of terms is found in the later chapter on glacial erosion. It is there concluded that the over-deepened main troughs as compared with the hanging side troughs of deglaciated mountains are due only secondarily to glacial erosion and chiefly to erosion by subglacial streams; and support for this view is found in the above (mis-)interpretation of tropical side-stream channels as "hanging valleys." The absence of the deep-cut chasms which ought, under this view, to occur at the mouths of hanging lateral troughs is accounted for by the improbable and altogether unproved assumption that the subglacial side streams descended from the hanging side troughs through the ice of the main trough.

This discussion of glacial troughs makes part of a section concerning the long-debated question of glacial erosion, naïvely entitled "Impartial Consideration of the Dispute," from which one may infer that in Passarge's opinion the "dispute" has not been impartially considered by others; and it is probably true that no one else has headed his discussion by the word "impartial" with its connotation of self-satisfaction. The consideration opens with a truism: "If one wishes to decide a disputed question, one must first separate facts from suppositions." The facts are therefore gathered under ten headings (pp. 319–320), of which the last is the most important, namely, the constant association of cirques, overdeepened troughs, trough floor sills, rock basins and fiords (hanging side troughs are not explicitly mentioned), in deglaciated mountains; but the largely deductive discussion of these facts (pp. 320–323) is not satisfactory. Trough floor sills are regarded as unsolved problems, in spite of their close analogy with hard-rock sills in river beds. Lake basins at the end of overdeepened glacial troughs, where they emerge from a mountain mass upon a piedmont lowland, are not accepted as merely the terminal part of the overdeepening which the troughs have suffered all along their length but are ascribed to valley warping; Wallace's decisive argument against this explanation seems to be unknown. The importance of deep preglacial weathering as an aid to the glacial erosion of troughs and basins is overestimated.

The chapter on glacial erosion gives as a whole the impression of being based more on reading than on observation; and glacial deposits do not receive the share of attention they deserve in comparison with soils and sand dunes. Till plains especially are passed over too briefly. The nineteen pages on coral reefs are also, naturally enough, "read up" but not sufficiently; for they fail to include among the evidences for submergence in connection with reef growth either the prevailingly unconformable contact of reef limestones with the rocks of the islands they encircle or the embayments of the encircled islands. The chapter on coasts does not seem to have fully aroused the author's interest; and among its explanations, into which deduction is repeatedly given free admission, some are inadequate. It is said, for instance, that after a steep, still-standing coast is cut back so far that even storm waves cannot remove the cliff-base detritus, abrasion will cease (pp. 386–396); but this overlooks the continued deepening of the abraded platform as a result of which attack on the cliff base will go on with platform abrasion in adjusted proportions. On the other hand, the preceding chapter on wind action may rank with those on soils as among the best in the book, even though it does not make sufficient mention of the interaction of wind and water in the production of plains of desert degradation; and that is curious, for this compound process is one concerning which Passarge himself announced a most original and important generalization on his return from South Africa about twenty years ago.[4] But neither in this chapter nor in any other of Part II are plains of degradation duly treated: they are postponed to the final pages of the book, where the explanation proposed for them is presented quite apart from its proper context, as if to close the volume with a surprising climax.

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[4] Siegfried Passarge: Über Rumpfflächen und Inselberge, *Zeitschr. der Deutschen Geol. Gesell.*, Vol. 56, 1904, Monatsberichte, pp. 193–215.

An Elaborately Systematic Classification

After the greater part of the volume has been devoted to erosional processes, Part III (pp. 468–522) takes up the forms of the lands, not to describe them, for that has been done empirically in the first volume; nor to explain them, for that has been done piecemeal in Part II of the present volume; but to classify them "according to their manner of origin in a natural system." The system proposed is extremely systematic. It includes types, classes, orders, families, genera, and subdivisions of genera and thus becomes so elaborate that its general adoption in landscape description is altogether improbable. There are two leading types, land forms and coast forms; then follow two classes, endogenetic and exogenetic. The first class is divided into three orders, tectonic, volcanic, and seismic; the order of tectonic forms is divided into three families according to their structure, flexed forms, faulted forms, and folded forms. In the second class, exogenetic forms, no attention is paid to the structure on which the external processes work but only to the processes; and the class is then divided into three orders, dissected or degraded forms, aggraded forms, and chemically modified forms (chiefly soils). The orders of degraded and aggraded forms are each divided into ten families, which are named after the ten controlling agencies, beginning with lightning and ending with man. To illustrate the detail to which this scheme is carried, it may be noted that, under the order of aggraded forms, the family of lightning-made forms includes but one genus: namely slopes at the foot of cliffs which lightning has shattered!

Passarge's Views on Peneplanation

Finally, not classed as a Part or a Chapter of the book but standing by itself, comes a "Concluding Consideration" (pp. 516–522); and here at last Passarge presents, after a condemnation of another physiographic scheme than his and a justification of his own scheme, the postponed explanation of plains of degradation. It is printed in spaced letters as a sort of dénouement to the volume. The explanation first states that both at times of upheaval and at times of climatic change degradation is stimulated; but, while upheaval with increase of seaward slope results chiefly in greater linear erosion by streams, certain changes of climate result in greater areal degradation. In view of this a fundamental law, based on a suggestion made by Passarge's teacher, von Richthofen, in 1905 is formulated: "Extensive and deeply penetrating planation is the consequence of repeated climatic changes." For example, when a climatic change transforms a temperate, forested, hilly upland into either a sub-arid steppe or a sub-frigid tundra, the deep-weathered soils of the hill slopes that were—according to Passarge—practically stationary under the forest cover will be actively removed; but they will be formed again if a moist temperate climate returns. If such changes happen repeatedly, the hilly upland will be degraded to a low plain. Thus it is thought that all plains of degradation in temperate latitudes—but not plains of abrasion—are to be accounted for and not by soil creep under a forest cover in a persistently moist climate. Climatic alternations from arid to rainy in the torrid zone are similarly held responsible for the production of extensive degradational plains with their surviving "Inselberge," such as those of Central Africa.

This novel principle is manifestly a deduction, and, in view of the mistrust of deduction previously expressed, the confidence with which the principle is here announced is somewhat surprising. As a matter of fact the principle, ingenious as it is, has not been tested sufficiently to warrant its acceptance as a replacement of the more generally accepted idea that peneplanation has ordinarily been accomplished chiefly by the long-continued action of the erosional processes of a single climate. It is of course easy to imagine, as Passarge does, that climatic changes have been caused by shiftings of the zones of temperature and rainfall; or even, as he directly asserts, that the earth's axis has been displaced enough to convert a temperate to a polar climate in certain longitudes and an equatorial rain belt into a desert in the same longitudes; but surely the occurrence, to say nothing of the frequent repetition of such changes in post-Mesozoic time, has not been demonstrated. It is also easy to assume that, if a still-standing land mass should suffer changes of climate often enough, it would in the end be worn down to a plain; but it has not yet been shown that any worn-down region really has suffered climatic changes of sufficient number to bring about its peneplanation in this way; nor has it been shown that a forest-covered region cannot be slowly degraded to lower and lower relief, largely by surface wash and soil creep, and thus eventually reach peneplanation.

It would seem indeed that Passarge, in assuming that climatic alternations have occurred in sufficient numbers to accomplish peneplanation, has committed an error of the very kind that he charges upon those who, as he puts it, have assumed the occurrence of soil creep under a forest cover in order to account for peneplanation in a moist temperate climate. More caution was exhibited in this respect by von Richthofen himself than by his pupil; for the old master's quoted suggestion concerned only dry plains of degradation in the torrid zone and was, moreover, phrased as a qualified possibility rather than as an established conclusion as to their origin: "The proof of a repeated alternation of pluvial periods with increased surface wash and of dry periods with intensive wind action might give a key to their explanation."

Most American observers adopt the simpler explanation above intimated: namely the long-continued action of existing processes, either arid or humid. It is quite possible that other processes were in operation during former geological periods in regions now peneplains, just as glaciers may have aided in the degradation of the North Carolina mountains in the days of their lofty youth; but with us the existing processes are usually held responsible for the results now visible, and it is commonly believed that the results would have been essentially the same had no other processes ever acted.

In the introduction to the first volume of this work, the study of the landscape is stated to be a branch of geography that has only lately gained recognition. It is certainly true that, in spite of all the work done by the earlier physical geographers, the careful description of land forms has been slowly developed as part of a geographer's duty. How far Passarge's method of treatment will increase such description remains to be seen; but it is to be feared that, in spite of the insistence he places on direct observation and empirical description in his first volume, a distraction from explanatory description toward analytical explanation will be the result of his third volume. In geomorphogeny, or the study of the development of land forms, such analytical explanation is appropriate enough, and it has been highly developed by German geographers as may be seen in the essays contributed to the Penck "Festband" of a few years ago;[5] but in the explanatory description of the visible landscape it is not the development of land forms but the developed forms that should stand in the foreground; and hence in such description the geographer should so contrive his phrases that the attention of his readers is held to the visible present instead of being left in the imagined past, as so often happens when process instead of product is given strong emphasis. In this respect Passarge's "Landschaftskunde," learnedly analytical as it is, leaves much to be desired.

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[5] See *Geogr. Rev.*, Vol. 10, 1920, pp. 249–261.

A POPULAR GEOGRAPHIC CLUB OF SWEDEN

THE SWEDISH TOURING CLUB AND ITS ACTIVITIES

By Carl Julius Anrick

In former days the northmen's love of journeying to foreign lands was known and dreaded through their pirate expeditions along the coasts of Europe. In modern times Sweden's contributions to geographical discovery, under names like Nordenskiöld, Hedin, and J. Gunnar Andersson, illustrate the Scandinavian love of exploring new lands and their geographical conditions. It is the same feeling that finds expression in the common desire of Swedish people to travel about in their own country and to know with their own eyes its different provinces; and this desire, together with their deep appreciation of nature has produced in Sweden a touring club which in size and importance stands in the foremost rank among the tourist associations of various countries.

Objects of the Club

The Swedish Touring Club was founded in 1885, a time when the development of modern means of communication was opening up to the general public the less known parts of their own country. The Club set up as its program development and facilitation of an internal tourist traffic with the purely ideal object of spreading knowledge concerning the country and its people; but its contribution to Swedish cultural efforts soon became greater and more comprehensive than this. Now, after less than forty years of work, it may truthfully be said that it has contributed in a considerable degree to geographical research.

The continued efforts of the Touring Club to make the Swedish mountain districts known and visited have certainly served to waken an interest in these parts of the country among ever widening circles; and the plans of the Club have often made possible regional studies which would otherwise have been impracticable. The Club started this branch of its work as early as 1887, and by its provision paths have been cut and roads laid in the wilderness, and many buildings have been erected. The first unimportant little huts, wherein the wanderer was merely afforded shelter, have given way to large, modern tourist hotels, many of which are now owned by the Club and are the last outposts on the edge of the wilderness. The best known of these are probably the hotel at Abisko (with rooms for about 120 guests) situated on Torne-träsk and reached by the recently electrified Luleå-Narvik railroad and the hotel at Saltoluokta (with rooms for about 60 guests) not far from Stora Sjöfallet, the largest group of waterfalls in

Europe. The Club now has in its possession six large tourist stations, 28 cottages and huts, a large number of tents (*kåtor*) of the Lapland type, and several lookout towers and other small constructions—all built, for the most part, under the direction of the Club. The Club, furthermore, runs motor boats through many of the principal bodies of water in Swedish Lapland. Through the Club's chain of cottages and tents, which is particularly concentrated around the mountain tracts of the province of Jämtland south of the Jämtland railroad and in Lapland in the province of Norrbotten, it is now possible to take walking trips of several weeks' duration with provision for shelter every night in tracts otherwise entirely desert.

Of far greater geographical interest, however, is another branch of the work of the Swedish Touring Club—its publications and maps.

Yearbooks and Handbooks

Foremost among these is the encyclopedic geographical manual of Sweden constituted by the successive numbers of the Yearbook (Svenska Turistföreningens Årsskrift). It is through this work that the Club has succeeded in winning its great popularity and large membership. In the first decade of its existence the Yearbook was largely filled with accounts of journeys to the most distant tracts of Sweden; at the present time it comprises mainly a popular monograph in several sections on some one of the twenty-four Swedish provinces, the foremost specialists of the country thus making their contribution to the discussion of natural conditions and cultural peculiarities in the respective provinces. The geographical panorama of their own country which the Yearbooks will spread before the majority of Swedish readers by the time that all the provinces have been treated will probably be unequaled. Since the year 1915, when the "Province Series" was commenced, the Yearbook has treated the following provinces: Uppland (1915), Småland (1916), Bohuslän and Göteborg (1917), Västmanland (1918), Skåne (1919), Ångermanland (1920), Öland (1921), and Hälsingland (1923)[1] as well as the capital, Stockholm, and its environs (1922). Next year (1924) will be devoted to Västergötland.

The Swedish people's evaluation of the Touring Club and its Yearbook is best shown by the development of its membership roll, which has increased every year as shown by Table I (p. 611) until it now stands at 98,308.[2]

This membership of nearly 100,000 is seen in its true significance when one considers the fact that the entire population of Sweden consists of 5,800,000 persons. One out of every 58 inhabitants, therefore, is a subscriber to the Swedish Touring Club and gives his support by a yearly contribution of 5 Swedish crowns, for which he receives the Yearbook and a small circular free of charge. As the Club receives no state or community support and no private donations, its entire work is carried on by these dues.

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[1] The extent and plan of the work may be illustrated by the following figures which apply to the last of the 36 volumes: number of pages, 398; number of illustrations, 358; number of maps, 4; number of principal articles, 20; of smaller contributions, 19; first edition, 107,000 copies; second edition, 5000. For an example of the type of contribution to the Yearbook see elsewhere in this number of the *Review* Dr. De Geer's article "Greater Stockholm," adapted from the Yearbook for 1922.

[2] Detailed statistics of membership and other matters relating to the activities of the Club will be found in the "Circular" for the past year (No. 42, 1923) and in "The Swedish Touring Club" (Svenska Turistföreningen, Några siffror och bilder från dess verksamhet 1885–1915), by H. Kjellman, Stockholm, 1915.

After the Yearbook, the most important of the Club's publications is its series of travelers' handbooks. Here, also, the grouping is according to provinces, the entire country being covered in 17 volumes of provinces (based on the ancient divisions of the country) together with one volume on the capital and two on special mountain tracts in Jämtland and Lapland (see Fig. 1). These books, which are of ordinary handbook size, contain variously from 200 to 400 pages and are well illustrated and provided with maps. They serve the public not only as guides on trips and walking tours—being much more detailed than ordinary guidebooks—but also as reference books on the respective districts. In this series special mention ought to be made of Professor A. Hamberg's book on Mt. Sarek,[3] which comprises a geographical monograph on the most thoroughly explored of the Swedish mountain massifs.

The Club has also published a large number of pamphlets, guidebooks, and descriptions of separate districts to secure the data for which it has every year, for a long period, supported geographical expeditions. Many young scientists have in this way been enabled to undertake expeditions in the Swedish mountain regions.

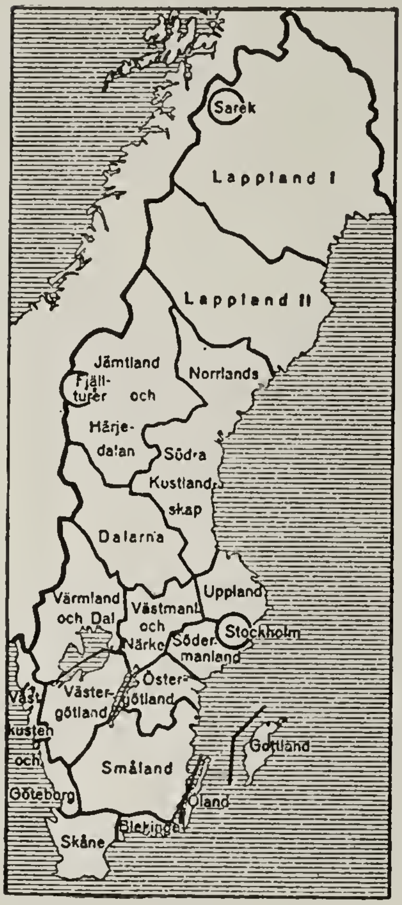

FIG. 1—Divisions of Sweden treated in the Swedish Touring Club's series of handbooks.

MAPS

A distinct part of the Club's many-sided activities has, of course, been the publication of maps. In its guidebooks the Club has already given good proof of its cartographical capabilities. When it was a question of constructing the map of a city or of any other area the Club has always insisted on a true geographical presentation; and in the matter of city mapping it is one of the first institutions to aim at giving a picture of the city's geographical unity rather than its administrative setting and also to show the place as it exists today and not its possible future appearance.

Inasmuch as at the time of the Club's first activities in the mountains the map of the Swedish General Staff did not include all the mountain regions, the Club very early attempted to give the climber the necessary equipment for those regions where the Club had stations, through the publication of all accessible map material. In this way there originated maps of the Jämtland mountains which are still, in new editions, the best tourist maps of these regions. These maps were published on the scale of 1:100,000 and are provided with contour lines, with shading to show relative heights, and with special coloring for those portions of the district that lie below tree line.[4] Now that the General Staff maps have finally been issued, several of these maps have lost their original importance; but the map of the mountain districts south of the Jämtland railroad is still probably the most extensively used map for these districts, on account of its inclusiveness and clearness.

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[3] Axel Hamberg: Mount Sarek: A Guide for Walking Tours in the Mountains Between the Sources and Branches of the Lule River (Sarekfjällen, Vägledning för färder i högfjällen mellan Lule älvs källarmar, *Sv. Turistföreningens resehandbok No. 27*), Stockholm, 1922.

Table I—Membership of the Swedish Touring Club

Year	*Number of Members*
1885	67
1890	3,274
1895	12,308
1900	25,535
1905	36,323
1910	51,659
1915	60,185
1920	94,407
1922	98,308

While the tourist maps of the mountain regions of Jämtland, made under the direction of the Swedish Touring Club, may be called good, the maps of Lapland unfortunately leave much to be desired. The tremendous expenses and difficulties associated with map making in this region have prevented the government from making a much-needed new map. The Touring Club also has been unable to arrive at anything but a revision of maps already accessible. However, its press has issued the map compiled by Professor A. Hamberg of the place names of Mt. Sarek, which contains a great many of his observations on this mountain range made during twenty-five years of work.[5] To meet the demand for maps of Kebnekaise, the highest mountain of the country (2123 meters) and one of the chief objectives of mountain climbers in Lapland, the Club finally in 1922, regardless of costs, sent out a cartographical expedition which is now engaged in producing a map of this region by photogrammetric method.

The maps published by the Club have at present (July, 1923) reached the number of about 550.

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[4] Mention may be made of No. 5, Vällista-Anaris Mountain, 1:100,000, 1901; No. 13, Storlien-Tännforsen and its Environs, 1:100,000, 1919; No. 7, Högfjällen, in Southern Jämtland, 1:100,000, 1923, by E. Peterson-Berger.

[5] A. Hamberg: A Map of the Place Names in Sarek Mountain Region (*Karta över ortsnamnen inom Sarekfjälltrakten*), 1:300,000, 1922.

The most important of all the Club's cartographical contributions is the preparation of an atlas of Sweden on the scale of 1:100,000, which it is expected will be completed during the years 1922–1925. The first third[6] has already been issued gratis to the members of the Club. In this undertaking the Club has undoubtedly achieved a permanent atlas of Sweden, one which will be of service even outside the borders of the country.

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[6] See the review by Professor Jefferson elsewhere in this number of the *Geographical Review.*

AMERICAN GEOGRAPHICAL SOCIETY

RECENT PUBLICATIONS

The New York Walk Book. The welcome accorded Dr. Dickinson's small guide, "Palisades Interstate Park," encouraged the Society to undertake the publication of a larger work on the same order—the "New York Walk Book," in which Dr. Dickinson has the assistance of Messrs. Raymond H. Torrey and Frank Place, Jr.

The area covered by the book lies within 40 to 50 miles of New York as a center and with several offshoots to more distant regions of special interest. Among the regions covered by the chapters into which the book is divided are the following: Greater New York; Long Island; south-central New Jersey from Sandy Hook to Barnegat, including the Pine Barrens; northern New Jersey, including the Watchungs, the Highlands of Passaic County, and the Lake Hopatcong region; Westchester County; the Highlands of the Hudson and the Ramapos, including new trails in the Interstate Park and the Stillman Black Rock Forest; the Greenwood Lake region; Putnam and Dutchess Counties; and such outlying regions as the Kittatinnies, Catskills, Taconics, and part of Connecticut.

For each region the directions for the walks are preceded by notes on the scenery, geological formation, flora, and points of historical interest. Each walk is described in minute detail. Instructions are given as to means, time, and cost of transportation; and information as to type of country and average walking time. Seven maps in color on the scale of 2 miles to the inch, based on the sheets of the U. S. Geological Survey, show by contours the topography of the country and contain all the roads, trails, and towns mentioned in the text. The book is profusely illustrated with 80 of Dr. Dickinson's pen-and-ink sketches which so delighted purchasers of the book on the Palisades Interstate Park published by the Society. An appendix contains sections on the geology, physical geography, and flora of the regions covered by the walks; proper equipment for tramping, lists of outing clubs and stop-over places, and a brief bibliography of books and maps covering the regions.

Aids to Geographical Research: Bibliographies and Periodicals. The purpose of this volume, *Research Series No. 10*, by John Kirtland Wright, librarian of the Society, is to introduce the student to certain reference books, periodicals, and bibliographies which are of outstanding utility from the geographical point of view and to suggest how best they may be used. The selection of titles to which references are given has been critically made. The work when in manuscript was submitted to several of the leading geographers of the United States, England, France, Germany, and Italy and as a result of their constructive criticism was much enhanced in practical value.

The volume is divided into five parts. The first consists of a discussion of the bibliography of materials not specifically or exclusively geographical but which none the less may frequently be of service to the geographer: government documents, publications of learned societies, publications devoted to geology, meteorology, history, economics, and other related spheres of investigation. The second part deals with general geographical bibliographies; the third with the bibliography of maps; the fourth offers a few practical suggestions in regard to effective methods of finding geographical material; and the fifth consists of two annotated lists of geographical periodicals and bibliographies of regions. Alternate pages are left blank in Part V for the insertion of additional notes.

The Land Systems of Mexico. The Society's program of geographical research in Hispanic America embraces among other studies the important subject of land tenure. This has been touched upon in the volumes "The Agrarian Indian Communities of Highland Bolivia" by G. M. McBride (*Research Series No. 5*), and "Recent Colonization in Chile" by Mark Jefferson (*Research Series No. 6*). A more comprehensive study now appears in Dr. McBride's "Land Systems of Mexico" (*Research Series No. 12*). Justification of this piece of research, if such were needed, is given by Sr. Manuel Gamio, the distinguished Mexican anthropologist, who writes the introduction: "The agrarian question has been the most powerful factor in the development, past and present, of the Mexican people."

The agrarian question in Mexico is old: it goes back to preconquest days, when already the limited fertile areas in Mexico's chief agricultural zone were the subject of dispute among the populous Indian tribes. At all critical moments in the subsequent history of the country the fundamental nature of the land question has been apparent. It was an underlying cause in the War of Independence; a prime feature in the mid-nineteenth century reform movement; and the last revolution may properly be described as an agrarian revolution. It was on reform rather than political questions that appeal was made to the mass of the Mexican people in the overthrow of Diaz; and land reform is the chief result so far accomplished by the revolution.

But the present is still in the main a heritage of the past. The backwardness of rural Mexico is nowhere more apparent than in the system of land tenure. A large portion of the land is still held under conditions similar to those that obtained in Spain before the Discovery while other areas are controlled by a similarly ancient system of aboriginal origin. These are the forms of land tenure represented respectively by the *haciendas* and the collective Indian holdings.

The *haciendas,* the great estates, are the most prominent feature of the land system of today, claiming attention by their permanence, size, and dominant influence in the national life especially socially and politically. Opposed to this system of *latifundia* is that of the communal Indian holdings. Although these were legally abolished in the mid-nineteenth century, they have been largely maintained in open or covert defiance of the law. Agrarian Indians constitute a large proportion of the population in several states of southern and central Mexico, and communal tenure is the only form they understand. The most recent movement is one to restore land to the towns for collective purposes until the time is ripe for individual ownership.

The third important form of land tenure in Mexico is the *rancho,* the term being used in the sense of a small rural property worked by the owner himself and his immediate family. The *ranchero* is generally a mestizo and, in contrast with the typically absentee landlord of the *hacienda,* is a real agriculturist. It is interesting to note that the origin of one form of *rancho* may be traced to early agricultural settlers from Spain, "almost the only example in the New World of Spaniards becoming real colonists and cultivating the soil with their own hands." It is this class that is seen as the hope of Mexico, the basis of a middle class and a democratic state.

After a preliminary chapter on the geographical setting Dr. McBride treats each of these classes in separate chapters, tracing the development of each and the relation of their systems to geographical conditions. A chapter on the distribution of rural holdings in Mexico sums up present conditions while the book concludes with a pertinent question as to the adaptability of present trends to physical circumstances. In addition to many photographic illustrations there are maps of the important geographical elements and of typical landholdings.

GEOGRAPHICAL RECORD

SOUTH AMERICA

The Extreme Youthfulness of the Central Andes. The rapid uplift of the Andes in late geological time has given them at least two outstanding geographical characters: (1) partly dissected old erosion forms carved at a lower level and now standing at a high level; (2) extremely deep and steep-sided canyons and other evidences of youthfulness of topographic form. Proof of this conclusion has been presented in a number of publications during the past fourteen years, since Bowman's first physiographic description of the region in 1909 (Isaiah Bowman: The Physiography of the Central Andes, *Amer. Journ. of Sci.*, Ser. 4, Vol. 28, 1909, pp. 197–217 and 373–402; and *idem:* Andes of Southern Peru, New York, 1916, pp. 183–198). The paleontological evidence of the youthfulness of the Central Andes has been developed chiefly by Berry. A recent paper gives some additional facts (E. W. Berry: Bolivia's Least Known Mountain Range, *Natural History*, Vol. 23, 1923, pp. 73–85). He finds red beds at Corocoro on the altiplano or high plateau of Bolivia that are of Pliocene age, and at an elevation of 11,800 feet on a high pampa in the Sierra de Cochabamba he has found sediments also of Pliocene age. The essential part of his description is worth quoting in full:

"Much of the material was volcanic ash the only known source of which was many miles away in the great volcanic field of the western Andes. This ash deposit, partly wind blown and partly water laid, had buried the fruits and leaves of trees the near relatives of which are to be found at the present time only in the Yungas—not far away to be sure, but at much lower levels, and not extending upward more than half way to the 11,800 feet where the fossils were found. Hence it is inferred that these fossiliferous sediments have been uplifted more than a mile since the fossil trees lived in that region, and knowing that the latter are Pliocene in age, we get the minimum measure of the amount of uplift since Pliocene times."

The effect of this great uplift upon life distributions in the Andes is of course revolutionary in every sense. "Formerly a rain forest like that of the Amazon Basin extended across the site of the Andes to the Pacific coast, and probably beyond, for there is some geological evidence that the deeps found immediately west of the present coast were once land, which has since sunk on the seaward side of the great fault that runs along this part of the present coast. Relics of this former rain forest have been found in the rocks of both Peru and Chile, and traces of it are preserved at a number of localities in the arid uplands of Bolivia." In this connection see A. G. Ogilvie: Geography of the Central Andes: A Handbook to Accompany the La Paz Sheet of the Map of South America on the Millionth Scale (*Map of Hispanic America, Publication No. 1*, American Geographical Society, New York, 1922), p. 109 et al.

Distributional Studies in South American Ethnography. Dr. Erland Nordenskiöld has published Numbers 4 and 5 in his series of "Comparative Ethnographical Studies" of South America. In them he has followed the distributional method so successfully used in the earlier studies (see review in the *Geogr. Rev.*, Vol. 10, 1920, pp. 273–274). Number 4, "The Copper and Bronze Ages in South America," has a broad interest because of its bearing on Indian origins. No final conclusions as to the relation between the Copper and Bronze Ages in the New and Old Worlds are reached or indeed can be reached until Central America and Mexico are better known in this respect; but Dr. Nordenskiöld shows the use of a productive method. He has studied the copper and bronze objects of the territory of the Inca Empire with a view to relative chronology. Besides the finds of which conclusions as to age are possible, this study included examination of the early literature for light on usages at the beginning of the sixteenth century, of the depiction of such objects in pottery and textiles, of the evolution of types, and of all known analyses.

Dr. Nordenskiöld is of the opinion that the Copper and Bronze Ages of South America were of independent origin, having their roots in the Stone Age. He refutes the view, based on the low and seemingly erratic variation in the percentage of tin in the alloys, that a real Bronze Age never existed here. Such a view was based on too few analyses.

Mr. Bingham's finds at Machu Picchu in particular suggest a tendency towards deliberate standardization in late Inca times. A Copper Age seems to have preceded a Bronze Age throughout the terrain, the latter apparently arising in Tiahuanaco and spreading outward. In Colombia is no bronze, copper being alloyed only with gold; in Ecuador copper objects are much commoner than bronze; on the Peruvian coast copper objects also predominate, these being of local type while the bronze objects are of interior types; around Cuzco few objects of base metal do not contain tin; bronzes predominate at Tiahuanaco and are also in a majority in northern Argentina and Chile. The great spread of bronze thus appears to have been due to the spread of Inca dominion.

Study Number 5 is entitled "Deductions Suggested by the Geographical Distribution of Some Post-Columbian Words Used by the Indians of South America." The words are those for the domestic fowl, horse, cow, banana, firearms, scissors, European knife, needle, and fishhook. These are coined by the tribes or borrowed from Spanish or Portuguese, and their distribution thus gives hints as to trade or migration routes. For instance the Quechua word for fowl is widespread on the Rio Ucayali and Upper Amazon, showing extensive trade connections. The fact that the Carib tribes north and south of the Amazon have no common or related terms for any of the above objects is explained by separation through Guarani invasion and settlement in their territory in post-Columbian times. Dr. Nordenskiöld advocates also the mapping of all important words for pre-Columbian cultural elements, with a view to throwing light on early folk movements. While the method has obvious pitfalls, it should prove a useful adjunct to other lines of evidence.

EUROPE

Aerial Survey as an Aid in the Prehistoric Geography of Southern England. To the layman the reconstruction of prehistoric population groupings would appear to present singular difficulties, especially in lands of modern civilization where man has destroyed so much of his past handiwork. It is somewhat astonishing, then, to learn that "accurate plans of the fields of a group of communities that ceased to exist about 1500 years ago" have been made in southern England. With the aid of aerial survey Mr. O. G. S. Crawford, Archeologist to the Ordnance Survey of Great Britain, has traced in central Hampshire a system of ancient fields the limits of which are marked by low banks, locally termed lynchets (Air Survey and Archaeology, *Geogr. Journ.*, Vol. 61, 1923, pp. 342–366). It is well known that aerial photography catches the small inequalities of relief and color differences of the surface either invisible or hopelessly confused to the observer on the ground. As Mr. Crawford says, "From the air an orderly system is visible. The bands of lighter-colored soil are the field boundaries of a vanished agricultural community; they consist of broad low banks; and their lighter colour is caused by the admixture of small grains of chalk." Associated with the ancient field system are boundary banks, roads, and remains of villages, the whole pertaining to a civilization dating from about 500 B. C. to the Saxon invasion (as proved by excavation in the village sites). The early grouping, labeled Celtic for convenience, is confined to the uplands. In contrast to it is a later system introduced by the Saxons, also distinguished by the aerial survey. The Saxon fields were of different shape—long strips, instead of the checkerboard pattern of the Celtic fields—and ran in terrace fashion above the villages, which were situated on the stream banks. As Mr. Crawford pointed out in his paper on "Prehistoric Geography" in the April, 1922, number of the *Geographical Review* this valleyward movement was the most revolutionary shifting of population in Britain until the modern industrial age. (See also the illustrations in the same author's publication in the Oxford Geographical Studies, "The Andover District: An Account of Sheet 283 of the One-inch Ordnance Map," Oxford, 1922.)

In addition to the intrinsic value of the work described above for the regional study of southern England, it is a useful demonstration of the importance of aerial survey in distributional studies, whether of past or present. As applied to archeology Mr. Crawford himself describes it as "an instrument for research comparable only to that provided by excavation." There are other striking examples of the same application which have a very definite geographical bearing. Among the most striking, for instance, is the mapping of the ruins of a vast ancient city on the banks of the Tigris by Lieutenant-Colonel A. G. Beazley during the war (Air Photography in Archaeology, *Geogr. Journ.*, Vol. 53, 1919, pp. 350–355).

The Eastern Alps as Fault-Block Mountains. An account of the old features of the eastern Alps by Professor Eduard Brückner of Vienna ("Alte Züge im Landschaftsbild der Ostalpen," *Zeitschr. Gesell. für Erdkunde zu Berlin* 1923, pp. 95–104) is of especial significance in showing that, at least for the eastern area where Brückner and his students have been working, the Alps are not carved in folded and broadly overthrust masses but in fault blocks which were unevenly uplifted by vertical forces after whatever lofty disorder their region had previously gained by compression had been reduced to moderate or low relief. Many high-standing areas are instanced in which the rolling surface, with a relief of 200 or 300 meters, is markedly discordant with the deformed structure. Some of these rolling highlands are composed of limestone, others of slate or of schist. Their altitudes vary from 1000 to 2000 or 3000 meters. Where revived erosion has not consumed the preexistent forms, rounded ridges have gentle slopes which decline gently into broad valley floors, as if they had been subdued by the slow action of soil creep, although they are now divested of soil cover. The broad valley floors in certain limestone highlands are the site of occasional quartz pebbles, the source of which must have been in the central Alps, although source and site are now separated by young and profoundly deep valleys. Evidently a late mature or old stage of degradation must have been reached when the region was much lower than now; and the present altitude of its highland areas must be due to later upheaval. The upheaval is believed to have been accomplished by block faulting, with more or less displacement and warping, at two epochs separated by a pause of a considerable duration, because the present sculpturing sometimes shows valleys of two-cycle forms. Inasmuch as the overthrusts of the eastern Alps are of Oligocene age, while the upheaval with faulting is dated as chiefly within the Miocene, it follows that the reduction of the lofty overthrust masses to late mature or old forms must have been accomplished within a single division of Tertiary time. Where the total uplift was so strong as to permit glaciation not only during the glacial period but also before and since, the subdued forms of the uplifted old mountains have been consumed; they are now sharpened into serrate crests. Where the uplift was of less amount, glacial cirques are excavated locally, but subdued forms survive around them. The limestone highlands frequently have huge sinks of solvent erosion excavated in their valley floors. The original area of the uplifted highland blocks has been greatly reduced by the erosion of new valleys, the larger ones of which appear to have been located along belts of less elevation; but this aspect of the problem is not particularly treated. The edge of the residual highland surfaces is often well defined where it is undercut by the steep slopes of the widening young valleys. Some of the block faulting must be of relatively modern date, for in certain districts fault scarps measuring as much as 300 meters in height have been traced for two or three kilometers across not only the uplifted old forms but also across the new valleys incised beneath the old forms; and a few very young scarps, four or five meters high and up to 300 meters in length, have been found without any talus as yet formed along their base. These are presumably associated with earthquakes, which are of not infrequent occurrence.

The idea that the region of the Alps has been greatly degraded since its compressional folding, that its present altitude is due chiefly to subsequent vertical upheaval, and that its present mountainous form is the product of revived erosion is not new; but no previous presentation of this interpretation of its history is so clear or so convincing as that which Brückner now presents for its eastern portion.

W. M. Davis

The Draining of the Zuider Zee. Brief reference is made in this number of the *Geographical Review* (p. 509) to operations sanctioned by the Dutch government in 1918 and actually begun about two years ago which will result ultimately in the draining and conversion into arable land of the greater part of the area now occupied by the Zuider Zee. A full discussion of this subject, based upon "personal impressions" together with a study of recent official and semi-official Dutch documents and illustrated with many maps, diagrams, photographs, and airplane views, is given by Signor Enrico Maltese in *L'Universo* for June, 1923 (Vol. 4, pp. 447–482).

Work is already under way on the construction of the main dike (shown on the map in the present number of the *Review*, p. 109, fig. 2) which will connect the island of Wieringen with the coast of Friesland and will cut off the ocean waves and tides from the future fresh-water Yssel Lake. The surface of the latter will lie 16 inches below mean sea level. At mean low tide, however, its surface will lie 8 inches above sea level, the difference being sufficient to permit the draining off of the surplus fresh water twice a day through three great sluices. A canal, which, according to Signor Maltese, will be one kilometer wide, will preserve Amsterdam's water communications eastward. The four great "polders" (shown on figure 2, above) will each be divided into lesser compartments separated from one another by dikes, and, as the work progresses, to be successively thrown open to occupation. It is believed that the northernmost polder (No. 1) will be ready for cultivation in about seventeen years. The completion of the entire project will take from thirty to forty years.

Holland will gain direct benefits from this immense engineering work in the acquisition of some 772 square miles (2000 square kilometers) of agricultural land capable of supporting an estimated population of 250,000. It is very doubtful, however, whether the new fields can be sold for a price sufficient to defray the gigantic cost of construction. The operations, consequently, could hardly be justified were it not for numerous more indirect benefits. The most important of these will be the elimination of an ever-present danger of flood in the lowlands now bordering the Zuider Zee and the substitution of the relatively insignificant expense of maintaining 19 miles of sea dike between Wieringen and Friesland for the colossal expense of maintaining sea dikes around 200 miles of Zuider Zee coast line. Furthermore, the lower and more constant level of the Yssel Lake will facilitate the drainage of the surrounding country. The Yssel Lake will also serve as a reservoir supplying fresh water for the use of men and beasts in the provinces of North Holland and Friesland where, under present conditions, droughts not infrequently cause serious suffering in summer. The Yssel Lake and the canals entering it will furnish safer waterways for barges, canal boats, and other light-draught craft than do the shallow but often tempestuous waters of the Zuider Zee. North Holland will be connected with Friesland by a double-track railroad over the dike instead of by the present slow and uncertain ferry service. Finally, though the salt-water fishing industry of the Zuider Zee will be destroyed, its place will be taken by possibly even more lucrative fresh-water fisheries.

In conclusion Signor Maltese points out with much truth that "the diking off and partial draining of the Zuider Zee will mark the work of man that up to now will have most profoundly modified the physical geography of the earth."

AFRICA

Changes in the Nile Delta and Lower Nile; the Delta Lake Fisheries. At the present day the Nile enters the Mediterranean through two main distributaries, the Rosetta and Damietta branches. In very early times, however, there appear to have been three branches; Herodotus (about 450 B. C.) describes five; Strabo, writing at the beginning of the Christian era, mentions no less than seven; and Ptolemy (150 A. D.) refers to four. Scholars have long differed as to the identification of the names and routes of these various branches. The latest contribution to the subject (Prince Omar Toussoun: Mémoire sur les anciennes branches du Nil, *Mémoires Présentés à l'Inst. d'Égypte*, Vol. 4, Fasc. 1, 1922, Cairo) is based upon a critical study of classical sources made in conjunction with an examination of existing and former canals in the deltaic plain and of slight but significant variations in level. Strips of elevated ground more fertile than the surrounding country indicate the routes of former watercourses. Prince Omar supplies a map showing the position of these abandoned channels, together with a series of maps illustrating his reconstruction of the ancient topography of the region.

Aristotle asserts that the Canopic, or westernmost branch of the Nile delta, was the only natural outlet and that the others originated in artificial canals constructed to drain the low-lying flood plain. Whether or not this is strictly true, it is incontestable that man-made canals have in several cases marked out the routes subsequently followed by the main distributaries of the river. The lower courses of both the Damietta and Rosetta branches were probably determined in this manner sometime between the age of Herodotus and that of Strabo. Indeed, it would seem that the entire drainage of the delta has been radically altered since the fifth century before Christ by the construction of canals. Herodotus compares the region during the flood with the Aegean Sea, remarking that villages and towns stand like so many islands in a broad expanse of water. More recently, however, the flood waters, instead of being allowed to spread freely over the countryside, have been conducted to the fields and carried off to sea by a network of permanent irrigation and drainage channels.

The apex of the delta is gradually shifting northward, downstream. Prince Omar believes that the two main branches in classical times diverged at what is now the southern tip of the island of Warraq, about three miles below the outskirts of Cairo and ten miles upstream from the present water parting.

On or near the banks of the river, not far above the apex of the delta, have been the sites of towns of metropolitan importance from the days of the Pharaohs. The region as a whole—at the junction of routes up the delta from the Mediterranean, down river from upper Egypt, and overland (or, in past times, by canal) from the Red Sea and Arabia—is assuredly a natural situation for the growth of an urban community. Here arose Memphis of the ancient Egyptians on the western bank and, on the eastern, Heliopolis, Babylon, founded by the Persians, and the medieval Arab towns of Fustat and El Qahira, out of which has grown the modern city of Cairo. The sites of these towns, as distinguished from their situations, are discussed in a recent article by C. J. R. Haswell (Cairo: Origin and Development. Some Notes on the Influence of the River Nile and its Changes, *Bull. Soc. Royale de Géogr. d'Égypte*, Vol. 11, 1922, pp. 171–176). The ruins of Memphis, the pyramids of Giza some fifteen miles to the north, and the site of Heliopolis east of the river and below the pyramids are all well back from the present channel of the Nile. Mr. Haswell contends that in antiquity the river swung in broad curves which carried its banks much nearer these three points. The normal tendency of a river meandering through a flood plain is to increase the width of its curves; but this tendency, it would seem, was in the case of the Nile here arrested in antiquity by the building of a spur near Memphis and subsequently by other artificial measures indicated by Mr. Haswell. The river was straightened and now flows in a fairly direct northerly course. One result was to throw the channel to the east toward a blunt promontory of upland projecting into the plain. This promontory, comprising the heights of El Rasad and El Muqattam, was early seen to be of great strategic importance, and here was built the Qasr el Shama, or Persian fortress of Babylon. The ground between the northwest slope of the heights and the river became the site of Cairo. Mr. Haswell traces the successive stages in the growth of the city northward and westward over land reclaimed from the river.

The seaward border of the delta is fringed with four shallow, brackish lakes, Manzala, Burullus, Idku, and Maryut (the ancient Mareotis), separated from the sea by sand dunes and barrier beaches. Alexandria lies on the barrier beach between Lake Maryut and the Mediterranean. Unlike the other lakes, Maryut is unconnected with the sea at all times. Its surface is about eleven feet below mean tide level. The remains of quays on its shores and the fact that islands of the lake were formerly inhabited are interpreted by Prince Omar Tussun (*op. cit.*, p. 41) to indicate that in the past (the period is not definitely stated, but it appears to have been after the time of Herodotus) the waters of the lake stood slightly above sea level. Through a series of canals a permanent supply of water was then furnished Lake Maryut from the remote Lake Moeris in the Fayum oasis and served to maintain the higher level and freshness of the water of the former. Subsequently this connection was broken, and the canals were in places dried up or obliterated by sand. The level of Lake Maryut dropped, its water became saline, and the islands were rendered unsuitable for human occupation.

Lake Manzala is connected with the sea by a passage, the Gamil, known in antiquity as one of the "false mouths" of the Nile (Omar Tussun, *op. cit.*, p. 51). Lakes Idku and Burullus are so connected only during the months when the river flood opens a channel to the sea. All these lakes are extraordinarily shallow, ranging from a maximum depth of a meter down to a few centimeters over broad areas. The quantity of fish (*shobar* and mullet) found in the lakes seems inexhaustible. According to the Director of Fisheries Research, Egyptian Government (G. W. Paget: The Delta Lake Fisheries, *Cairo Sci. Journ.*, Vol. 11, 1923, pp. 1–10), the fishery industry on Lake Manzala alone employs 1640 boats and occupies "about 12,000 persons, of whom nearly half are boys under 12." The "shallow depth has conditioned both the type of fishing vessel and the kind of gear employed. The boats on Menzaleh and Brullos are all built on the 'skimming-dish' plan, on very fine and subtle lines. The largest vessels are about 36 ft. long and 12 ft. beam, of very shallow draft, and carry a single lateen sail whose yard may be 60 ft. in length. . . . Such a boat one often sees in the sole charge of two small boys whose combined ages probably do not exceed 18." The mullet of Lake Manzala spawn at sea. Consequently the spawning fish and lakeward bound fry have to pass through the narrow breach of Gamil. An area within a radius of six kilometers of this passage is closed to fishing from May to November, during the longer period of these migrations. "The date upon which this closed area is opened . . . is one of immense excitement to the community: and the sight of close on 1500 boats manned by over 12,000 fishermen breaking, at dawn, into this narrow space and struggling with yells and cries for the best places, is a most exhilarating one."

The Merja, Pastoral Marshlands of Morocco. The rôle of the mountain in pastoral life, described elsewhere in this number of the *Review*, is largely due to two factors, inaccessibility during part of the year and unadaptability to cultivation, whence the best use to which the land can be put is an extensive but seasonal pastoral occupation. Under very different circumstances these two factors may produce similar results, as witness the *merjas* of the Lower Sebu, Morocco (J. Célérier: Les "merjas" de la plaine du Sebou, *Hespéris*, Vol. 2, 1922, pp. 109–138, 209–239; and see also G. Hardy and J. Célérier: Les grandes lignes de la géographie du Maroc, Paris, 1922, pp. 87–90).

The Sebu reaches the sea through semiarid plains. The stream itself has sufficient volume to maintain its course throughout the year, but its tributary waters dry up in the summer. The Sebu carries much sediment and has raised its bed on the plains, now flowing between double natural dikes 8 to 10 meters high. Between these barriers and that of the belt of coast dunes the tributary streams are dammed up during flood season, whence the basin of the Lower Sebu has an amphibious character. In the summer it is a prairie; in winter it is transformed into a "mirror," to use the picturesque expression of the natives. The winter sheet of water is, however, not continuous; strips of dry land, of contour varying from season to season, separate the *merjas*, as they are termed, from one another. Altogether the *merjas* cover an area of some 150,000 acres. The depth of water is never great, the maximum being three to four meters, and this only in the winter and in the deepest parts which contain water at least during the greater part of the year. The zone between the upper and lower limits of the waters is covered by a luxuriant vegetation chiefly of reeds, rushes, and grasses. In addition to affording a safe asylum for bandits the *merjas* furnish the natives with hunting and fishing grounds and material for mats, tent covers, and huts. Their especial value, however, lies in their pastoral resources, whence the name *merja*, meaning pasture.

Thanks to the *merjas*, cattle raising along the Lower Sebu has taken on a greater proportional development than anywhere else in Morocco. The pastoral life of the region is typically divided into three seasons. During the winter rains the cattle occupy the fallow fields or the grazing grounds attached to the cultivated lands; after the harvest they are pastured on the stubble; and in the summer they go to the *merjas*. Rights to pasturage in the *merjas* are held by the riverine owners. In the case of the larger *merjas* they have far more than they require, and part is contracted out to other dwellers of the plain.

Unlike the high mountain the *merjas* are susceptible of improvement. By drainage a considerable area could be brought under cultivation, and such a project is under way. The matter is one that has occupied the attention of the government, since lands available for colonization are scarce. The project offers special technical and juridical problems. The latter, involving delicate questions of ownership for which there is no precedent, is an interesting case in "legal geography."

ASIA

The Mount Everest Expeditions of 1921 and 1922. The entire world followed with keenest interest the progress of the joint expeditions organized by the Royal Geographical Society and the Alpine Club and sent out in 1921 and 1922 for the exploration and, if possible, the ascent of Mt. Everest. Popular attention was naturally centered on these as great feats of sportsmanship. But much as we admire the courage and skill of the mountaineers, as geographers our primary concern is with the work of permanent geographical value accomplished, especially that accomplished by the expedition of 1921.

The history of the expeditions may be followed in the files of the *Geographical Journal* and the *Alpine Journal* covering 1921 and 1922. In almost every number of the *Geographical Journal* of these years there are articles, notes, photographs, or maps dealing with the subject. To the expedition of 1921 is devoted a superbly illustrated volume, by Lieutenant Colonel C. K. Howard-Bury and other members of the expedition, entitled "Mount Everest: The Reconnaissance, 1921" (Edward Arnold & Co., London, 1922). Here the broad narrative of the work done is given by Lieutenant Colonel Howard-Bury, the leader; the story of the reconnaissance of the mountain and its approaches is related by Mr. G. H. Leigh Mallory, mountaineer; two chapters on natural history and a list of mammals, birds, and plants collected are supplied by Mr. A. F. R. Wollaston; notes on the topographic and photographic surveys, geology, and scientific equipment are given in the appendices. A more complete discussion of the geological exploration will be found in Dr. A. M. Heron's paper in the *Records of the Geological Survey of India*, Vol. 54, Part 2, 1922, pp. 215–234. Special reports on the topographic surveys will be found in *Records of Survey of India*, Vol. 16, 1922, pp. 109–120.

The principal narratives of the 1922 expedition are in the *Geographical Journal*, Vol. 60, 1922, pp. 385–424; here the Chief of the Expedition, Brigadier General C. G. Bruce, and the Second in Command, Lieutenant Colonel E. L. Strutt, carry us from Darjeeling to the high camps on the East Rongbuk glacier; Mr. Mallory and Captain G. I. Finch, respectively, tell the story of the two high climbs. (Mr. Mallory's and Captain Finch's accounts will also be found in the *Alpine Journal*, Vol. 34, 1922, pp. 425–450.)

Owing to the restriction against foreigners entering Nepal, the attack upon Mt. Everest had to be made by a roundabout route through Tibet. This approach, however, was probably physically easier than would have been a more direct one from the south. Broad valleys lead to the glaciers from an altitude of 13,000 to 15,000 feet on the uplands of Tibet and form avenues of relatively gentle gradient up which travel and transport are not difficult. The southern approaches, on the other hand, are immensely steep and lie through teeming tropical and subtropical forests.

The expedition of 1921 left Darjeeling in May and proceeded by way of the Tang La, Kampa Dzong, and Shekar Dzong, to Tingri Dzong, forty-five miles northwest of the summit of Everest. Here the party split up. The surveyors, geologist, and naturalist undertook extensive explorations of the entire country surrounding Mt. Everest on the north, northeast, and northwest. The mountaineers, Messrs. Mallory and Bullock, repaired to the main mountain mass to carry through a reconnaissance for the purpose of finding a practicable route for the climbers of 1922.

Mr. Mallory fascinatingly recounts the various stages by which the explorers became familiar with the topography of the mountain and its intricate pattern of outlying ridges, summits, and glaciers. They soon observed that the route of the climbing parties must run up a broad buttress reaching to the northeastern arête of the main peak. All other routes were far too steep. At the base of this buttress is a 22,990-foot col, named by the explorers Chang La, between the main peak and a precipitous north peak, Changtse (24,730 feet). Attempts during June and July to reach Chang La from the great northerly-flowing Rongbuk glacier proved futile, and hence early in August the base was shifted to the Kharta valley, some thirty miles to the east. The discovery of the delightfully verdant and beautiful Kharta valley and its neighbor the Khama valley, lying almost under the shadow of the graceful peaks of Makalu (27,790 feet) and Chomo Lönzo (25,413 feet), was one of the surprises of the expedition. These valleys, with their sequestered inhabitants, are destined perhaps to become great mountaineering centers at some future date. From them the immense glaciers of the eastern slope of the Everest massif were explored, and finally, on September 24, Chang La was reached by way of the head of the Kharta glacier. This was a colossal feat of mountaineering, for there first had to be crossed a 22,200-foot col between the head of the Kharta glacier and that of a branch of the Rongbuk glacier. This branch, named the East Rongbuk glacier, was found to flow northwards from Chang La and the northeastern slopes of Everest in a valley parallel with the main Rongbuk glacier. So inconspicuously does it drain into the latter glacier, that its importance had been overlooked during the reconnaissance of the northerly approaches earlier in the summer. Nevertheless it was readily perceived that the East Rongbuk glacier was the only practicable route to Chang La and thence to the summit.

This was, accordingly, the route adopted by the expedition of 1922. That plenty of time might be available before the breaking of the monsoon towards the middle of June, the start was made in that year from Darjeeling about the first of April, and a base camp was already established in the Rongbuk valley by the first of May. Thereafter three other camps, each "fully rationed and supplied with a cook" were constructed on the East Rongbuk glacier. From these a fourth was pitched on the Chang La itself, whence two assaults were made upon the main peak. On May 21, from a fifth camp on the northern buttress above Chang La, Messrs. Mallory, Somervell, and Norton attained an altitude of 26,985 feet; and on May 26, after a terrible night in a tent at a sixth camp (25,500 feet) Messrs. Finch and Geoffrey Bruce, with the aid of oxygen, reached a point 27,235 feet high, within half a mile and 2000 feet of the summit. Even with the aid of oxygen, which proved a mighty boon, progress at these altitudes is painfully slow; and, as a furious gale was rising, Mr. Finch saw that to try to gain even 500 feet more would be fatal. The tragic circumstance of an avalanche, which killed seven porters below the Chang La on June 7, put an end to further climbing.

The outstanding difficulties in the way of a successful ascent of Everest, besides the ever-present one of acclimatization to diminished air pressure, are the shortness of the climbing season before the breaking of the monsoon covers the mountains with storm clouds, and the furious westerly gales which sweep over the peaks in fair weather.

From a strictly geographical point of view the primary result of the expeditions was the exploration and mapping in 1921 of an immense tract of unknown country. The positions and heights of the loftiest peaks, it is true, had long since been determined from afar by trigonometry. Quarter-inch surveys of Sikkim and of the highlands of Tibet northward to the southern watershed of the Tsang-Po had been made. But to the west of the 88th meridian (about 75 miles east of Everest) "there . . . remained a stretch of unsurveyed country some 14,000 square miles in area, between the Ladak Range on the north and the Great Himalaya Range on the south—the latter forming the northern frontier of Nepal" (Mount Everest: The Reconnaissance, 1922, p. 320). Of this tract, Major Morshead and his Hindu surveyors were able to map 12,000 square miles on a scale of four miles to an inch, the area thus covered running westward nearly to the 85th meridian. A revision was also completed of the quarter-inch survey of Sikkim, and Major Wheeler carried out a detailed photographic survey, using Canadian methods, of 600 square miles in the immediate vicinity of Mt. Everest. As a result of the summer's work the topography of a region lying within a radius of 80 to 100 miles northwest, north, northeast, and east of Mt. Everest is now understood in its essential features. The southern slopes in Nepal, being closed to the expedition, are still virtually *terra incognita*.

Dr. Heron's geological observations show that the area explored consists of two broad belts. To the south a zone of crystalline and metamorphic rocks is represented in the rugged relief of the Himalaya and Mt. Everest. Specimens collected in 1922 on Mt. Everest itself show the mountain to be "a pile of altered sedimentary rocks" probably of the Jurassic or Triassic period (*Geogr. Journ.*, Vol. 60, pp. 219–220). To the north of the crystalline and metamorphic zone lies a "Tibetan zone," consisting of much folded sedimentary Jurassic and later series out of which have been carved "the somewhat tame, rounded, and lumpy mountain ranges of Tibet, with their broad and flat-bottomed valleys" (*Records Geol. Survey of India*, Vol. 54, Part 2, 1922, p. 217). Unquestionably a most striking physiographic feature is the valley of the River Arun. This stream rises far to the northwest of Everest and, swinging around to the east, turns south to make its way into Nepal through profound and impassable gorges. Dr. Heron believes that the river cut its way back through the main range of the Himalaya and captured with its headwaters a former eastward-flowing stream. The course of the Arun and its gorge may be compared with the great gorge of the La Paz River in Bolivia (see A. G. Ogilvie: Geography of the Central Andes, *Amer. Geogr., Soc., Map of Hispanic Amer. Publ. No. 1*, New York, 1922, pp. 28 and 41). From the point of view of economic geology Dr. Heron states that the expedition of 1921 found nothing of interest.

Great as were the geographical results of the two expeditions, it is none the less to be regretted that circumstances did not permit the carrying out of more extended studies of land forms, glaciers, and local meteorology than appear to have been accomplished. Certainly no scientific observations on any of these topics have as yet been published. Dr. Heron states that he was able to devote "only an occasional day or two to the vicinity of the glaciers" but adds that "the present glaciers are but puny representatives of their former might, as shown by the huge moraines which encumber all the northern valleys." These moraines, the formerly glaciated valleys, the structure and movements of the ice, and the atmospheric currents in the profound valleys of these highest mountains of the world surely present problems of the first scientific importance awaiting solution by some future expedition. Let us also hope that a future expedition may enlighten us further on the distribution of vegetation and on the ecology of the region. From the human point of view these upland plains and mountain valleys offer an alluring prospect to the student of geography. Occasional sketches of life in Colonel Howard-Bury's absorbing narrative show us that this part of Tibet is inhabited by a people of mature and enduring civilization in whose monasteries and villages the ethnographer and expert in folklore will find a truly virgin field. Mountain regions in the tropics are unparalleled localities for studies of regional geography, because so many divergent types are there brought into close juxtaposition. It is to be hoped that a future British expedition may produce a monograph of the geography of Mt. Everest that will surpass in quality Dr. Klute's admirable study of Kilimanjaro, which may at present be taken as a model of what a regional investigation of a high mountain area should be (see *Geogr. Rev.*, Vol. 12, 1922, pp. 494–496).

We may add that among the foremost objects of the expedition of 1921 were to have been researches by Dr. Kellas into the physiological effects of extreme altitude. Dr. Kellas' death while on the journey into Tibet was therefore a doubly critical blow, for the experiments and observations which he had contemplated were perforce abandoned. The experience of the climbers, however, sufficed to show that the human body possesses remarkable powers of acclimatization to an atmospheric pressure of only about half that at sea level.

J. K. W.

A Submarine Eruption in the China Sea. On March 2, 1923, a submarine eruption was witnessed by a Japanese vessel off the southeastern coast of Indo-China in the direct steamship track between Singapore and Hongkong. Six days later a British vessel reported the existence on the spot of a small island "approximately 500 yards in length" in water 50 fathoms deep. The island was horseshoe-shaped, the mouth facing north or northeast, the slopes rising to a height of 80 to 100 feet at the west-southwest end where the ejected material was piled up under the influence of the monsoon (Two New Volcanic Islands in the China Sea, *Geogr. Journ.*, Vol. 62, 1923, pp. 35–38; and the additional note, p. 153). The island lies between Pulo Cecir de Mer and Great Catwick, the corrected position being latitude 10° 10′ 20″ N., longitude 109° 0′ 10″ E. In the previous month earthquake shocks had been felt by inhabitants of the former island.

On March 15–17 the French surveying vessel *Astrolabe* visited the island, taking formal possession of it (L'île des Cendres, volcan indochinois récemment apparu, *Comptes Rendus de l'Acad. des Sci.* [*de Paris*], Vol. 177, 1923, July 30, pp. 335–338). Great activity was displayed at this time. On April 5 when a geologist, M. Étienne Patte, was officially dispatched to the island it was much changed. Eruptions had ceased, and the island was reduced in size, the heels of the horseshoe having disappeared. The summit had the form of an almost horizontal arc of 60° and was 34 meters high; the interior slopes appeared as part of a broken amphitheater; the exterior slopes were slightly convex, falling at an angle of 19° to the bordering wave-cut cliffs. On April 20 another earthquake shock was felt on Pulo Cecir and the adjacent mainland. The British surveying ship *Iroquois* reported the volcano still active on May 8 and a new islet 100 feet long and one and a half foot high formed two miles to the south of the first. On May 27, when M. Patte returned to the island, the cliffs had receded farther, though some protection was now afforded by the platform of marine denudation brought into being. The area of the "Île des Cendres" was less than two-thirds that of April.

The spot where the eruption has taken place is not near any seat of volcanic activity of historic time. The material ejected, chiefly basaltic scoriae, however, includes fragments of a basalt antedating this last eruption, whence it evidently took place on the site of a former volcanco or at least in a volcanic region. The island of Great Catwick is built of tuff and basalt, and on Pulo Cecir the remains of an ancient crater can be traced. Basalt flows are of common occurrence on the adjacent mainland, and from the way in which they occupy the present valleys they are obviously of comparatively recent origin.

AUSTRALASIA AND OCEANIA

Distribution Maps of the Leading Australian Industries. An excellent graphic representation of Australia's three primary industries is given in a series of maps accompanying an article by R. G. Thomas, "Present and Probable Future Distribution of Wheat, Sheep, and Cattle in Australia" (*Proc. Royal Soc. of Victoria*, Vol. 34 (N. S.), 1922, Part II, pp. 117–127). The dot method is employed in the maps, which are similar to those of Finch and Baker in their "Atlas of World Agriculture;" but these maps are on a somewhat larger scale than the Finch and Baker maps, are based on later statistics (1918–1919), and are believed to represent more accurately the actual distribution. The addition of lines of mean winter rainfall and mean annual temperature aids the discussion of future expansion of the industries.

Wheat, which occupied 9,647,000 acres, 3.5 per cent of the world's total, was distributed in a belt of 124,000,000 acres paralleling the southeastern and southwestern coast lines. It is practically included within the isotherms of 60° and 65° F. and the winter isohyets of 7.5 and 15 inches. The temperature factor cannot be considered limiting; there is a considerable area with a temperature similar to the winter wheat-growing region of India. The 10-inch rainfall line has usually been considered the safe limit of wheat cultivation in Australia, but from the way this is transgressed in the south a considerable extension may be looked for here. As far as rainfall and temperature are concerned it is estimated that the wheat belt can be pushed farther into the interior by 138,000,000 acres and the actual acreage under the crop be increased to a total of 40,000,000 acres. At present the limiting factors are chiefly economic. This is clear in many instances, for example in the definite boundary along the Murray River where the wheat belt stops coincidently with the limit of railway facilities.

Sheep numbered over 85,000,000, 16 per cent of the world's total. Density of distribution reaches a maximum in the southeast and is roughly coincident with the wheat belt but extends farther inland and northward. The industry has not made very rapid progress in the last 20 years. It is suggested that expansion may be specially looked for in the Mallee lands of Victoria and South Australia, where, contrary to usual, stocking follows clearing and cultivation; along the southern coast of West Australia; and west of the present boundary in Queensland.

Cattle, because of their greater adaptability, are more generally distributed. Distribution tends to be inverse from that of sheep. The greatest concentration is along the coasts of New South Wales and Queensland where the rainfall exceeds 40 inches and where the influence of cities is apparent. The east as a whole is occupied, though the density could be greater in some sections; there are some unoccupied areas in the west that seem to be climatically suitable.

POLAR REGIONS

Norwegian Navigation on the Eastern Coast of Greenland. The eastern coast of Greenland up to today has continued to be the least accessible and least visited of the Arctic coasts near Europe. The breadth and thickness of the ice pack, which drifts south-southwestward along the coast under the influence of the polar current, have been considered an almost insurmountable obstacle. Only fourteen expeditions, all of a scientific order, are known to have penetrated this barrier from the east—those of Scoresby, 1822; Sabine and Clavering, 1823; Koldewey, 1869–1870; A. E. Nordenskiöld, 1883; Nansen, 1888; Ryder and Knudsen, 1891; Amdrup, 1893; Nathorst, 1899; Kolthoff, 1900; the Duke of Orleans and Gerlache, 1905; Wilson on the Baldwin-Ziegler expedition, 1905; Mylius Erichsen, 1906; Ejnar Mikkelsen, 1909; Koch, 1912. Furthermore, it is a fact that since the foundation of the Danish station of Angmagssalik in 1894 the ship provisioning the post has been able to reach it every year (in September) except in 1907. Norwegian hunters are also known to have visited these parts, but their voyages have either gone unrecorded or the records have been preserved in out-of-the-way places. It has remained for Captain Gunnar Isachsen, the well-known Arctic explorer, to open to us a new chapter in the history of navigation on the eastern coast of Greenland in a memoir entitled "Voyages of Norwegian Hunters to Greenland" (Norske fangstmaends faerder til Grönland, *Norske Geogr. Selskabs Aarbok*, Vol. 31–32, 1919–21, pp. 201–261).

The occasion of a controversy engaged in by the Danish and Norwegian newspapers as to the sovereignity of this region led Captain Isachsen to undertake a detailed inquiry in the Norwegian ports which sent boats to this part of the Arctic: he questioned shipowners and sailors and examined their records and the files of the local press. His investigations produced results of the greatest interest. We now know that from 1889 to 1920 not less than 81 Norwegian boats succeeded in breaking through the pack of the eastern coast of Greenland to hunt in its fiords. (Isachsen gives 82; but he includes the voyage of the *Hekla* in 1891, in which year this ship was chartered by the Danish government to transport the Ryder mission.) These voyages are the more remarkable in that up to 1908 most of them were accomplished by little sailing ships of under 100 tons register. Since 1908 all the Norwegian ships making the trip have been furnished with motors. The first voyage was made in 1889 by Captain Ragnvald Knudsen in the three-masted steamship, *Hekla*. To the north of Jan Mayen he found a broad opening extending into the pack in a westerly direction. It has long been known to Norwegian hunters under the name of "North Gulf" or "Bay." On July 11 Knudsen entered the "Gulf" and, not without a struggle with the ice, in five days sighted land near Cape Broer Ruys. He visited Franz Josef Fiord (latitude 73° N.); then, proceeding northward, rounded Clavering Island and pushed up to Ardencaple Inlet. On August 15 the *Hekla*, after having doubled the northeastern point of Shannon Island, got out of the ice and reached home with a capture of 267 walrus, 6 bears, and 24 musk oxen to her credit (*Aftenposten*, Christiania, Dec. 27, 1922, morning edition, p. 3).

With the exception of the schooner *Ino* which wintered at Angmagssalik (latitude 65° 30′ N.) in 1893–1894, all the Norwegian ships which have penetrated the pack by the "Gulf" have visited the sector between 70° and 76°45′ N., that is the region of the great fiords (Scoresby Sound and Franz Josef Fiord) and islands (Clavering, Sabine, Shannon). The trips have been made in July and the first fortnight of August. Two ships have wintered there; one in 1908–1909 near Cape Herschel, the other the following year. Knudsen's voyage dates back to 1889, but it was only after 1898 that his initiative was followed. That year two Norwegian ships hunted in eastern Greenland, the following year four, in 1900 eight—the largest number. In 1905 and 1908 there were seven; six in 1903 and in 1919; in 1920 only four. The decline is a result of the drop in the value of products of the hunt.

It is a well-known fact that the drift of the relics of the *Jeannette* led to discovery of the Polar drift from the Bering Sea to eastern Greenland. An interesting new confirmation is also given by Captain Isachsen. A Norwegian ship, the *Ragnvald Jarl*, chartered by the Wellman expedition in 1894, was crushed in the ice near Walden Island on the northern coast of Spitsbergen. The name board of the ship was found in 1921 near Julienshaab in southwestern Greenland, the same region in which the relics of the *Jeannette* were found in 1884.

Charles Rabot

Rasmussen's Expedition in the American Arctic Archipelago. Knud Rasmussen left Europe in the summer of 1921 to undertake an exploration of the northern shores of North America from the northwestern extremity of Hudson Bay to Bering Strait. The purpose was to collect data on the geography and natural history of these little-known regions and to study the Eskimo inhabitants, past and present. In addition to the leader the Danish expedition included Peter Freuchen, topographer; Therkel Mathiassen, ethnographer and archeologist; Kai Birket-Smith, ethnographer; and Helge Bangsted.

The expedition proceeded by the motor boat *Sökongen* to the trading station of Thule near Cape York, founded by Rasmussen in 1910, where seven Eskimos were engaged to accompany the party to America and taken on board with 72 dogs, sledges, and other equipment. Return was made to Gothaab, capital of the Danish stations of southern Greenland, whence on September 7, 1921, the expedition set out for Hudson Bay and 11 days later reached Lyon Inlet. The latter part of the voyage was rendered difficult by heavy pack ice encountered off Southampton Island. Winter quarters were established on an islet to the east of Vansittard Island, latitude 65° 54′ N., longitude 83° 50′ W. A hut was built, and the *Sökongen* returned to Greenland.

From October 1 it was possible to make reconnaissance trips by sledge. Many traces of habitations and of old encampments were discovered. "From our observations up to date (January 15, 1922)," says Mr. Rasmussen in his report, "Mr. Mathiassen is of the opinion that two culture strata are represented here. An older stratum, which, according to present Eskimo tradition, pertains to a race now extinct, the Tomit, who are represented by fixed winter dwellings of whalebones and turf. The only implement which up to now we have acquired from this period is a harpoon point. The sites of these old huts are always in elevated spots, where they would never be built now. They date from a time when sea level was relatively much higher (10 to 20 meters higher). It is not impossible that the primitive Eskimos in Southampton Island were the last descendants of the original population. A younger stratum is represented by the present Aivilik-Udelelik Eskimos."

On November 23, accompanied by Freuchen, Rasmussen set out for the Hudson's Bay Company's post at Repulse Bay. On the way they met a party of Eskimos, who hailed Rasmussen as "a kinsman from a far-away country," for he was able to understand their speech and they also could understand his Greenlandic dialect. From Repulse Bay Rasmussen returned on December 13, 1921, and Freuchen on January 2, 1922, the latter having gone south to Wager Bay where the *Fort Chesterfield* of the Hudson's Bay Company was wintering. On February 6 Mathiassen and Freuchen proceeded to a survey of Baffin Land from Gifford Inlet as far as and including a part of Admiralty Inlet. Much material was collected on this trip. Setting out on March 24, Rasmussen and Bangsted made an excursion to the south, reaching Chesterfield April 18 after visiting the Aiviliks and Netchiliks on the way. Pushing inland they arrived May 12 at the Hudson's Bay Company's station at Orpigtujog, an islet of Baker Lake, where since January 15 Birket-Smith had been engaged in anthropometrical measurements on Eskimos visiting the post. From there the explorers passed into the Kazan River valley to Yathkyed.

The following tribes inhabit the country from Chesterfield Inlet to Yathkyed Lake: the Gaernermiut, who have been erroneously called the Kinipetu, Sharvartormiut (lower Kazan River), Padlermiut, Shaunertormiut, and Tashiusharmiut. While the Gaernermiut and the Shaunertormiut now live in part along the coast during spring and summer, the other three tribes are distinctly inland people who have only begun during the last generation or two to make their way towards the sea. Some of them had never seen white men. These tribes have never been described before. Their only means of subsistence are reindeer hunting and salmon fishing: all that has to do with the sea is "taboo." Stone houses are unknown. During the winter they live in snow huts, unheated, as they have no blubber. The winter is exceedingly cold, often below—50° C. and always very windy. The kayaks which are used on the rivers and lakes are covered with old reindeer hides. Umiaks are unknown, but they have canoes such as are used by the Indians. Reindeer are killed by spear from the kayaks as the large herds swim across the rivers.

Among these Eskimos Rasmussen collected legends identical to the smallest detail with those he knew from Greenland. Not one-third of the Greenland implements are known here, however, and there is every indication that these tribes never lived near the sea. According to the opinion of the late Dr. Steensby of Copenhagen, the Eskimos were originally an American inland tribe which had wandered out to the Arctic coast. "It seems," says Rasmussen, "as if we here have found the corroboration of this theory. In all probability we have here in the inland tribes of the Barren Grounds the last surviving remnant of the primeval Eskimo, a survival from the time when the Eskimo people had not yet reached the sea."

On June 24 Rasmussen and his companions left Yathkyed Lake in two parties: Birket-Smith and Bangsted went by canoe down the hitherto unknown lower course of the Kazan River, of which a route map was made; and Rasmussen went to Baker Lake, whence both parties returned to their winter quarters off Lyon Inlet.

Further news from Rasmussen, dated December 15, 1922, comes from Lyons by way of Copenhagen. It states that the expedition has accomplished a considerable amount of geographical work in the last year. A map based on 500 astronomical observations has been drawn of the area about the winter station, including the western coast of Hudson Bay between Repulse Bay and Wager Bay together with the east coast and a part of the north coast of Melville Peninsula. Ethnographic studies have likewise been pursued with success. Recent reports relate to the Eskimos in the vicinity of the station—Aiviliks, Udeleliks, and Netchiliks. The speech of the two former is almost identical; that of the last is notably different. The life and customs of the natives have been profoundly modified by contact with the whalers who have long frequented the western coast of Hudson Bay. The first whaler in this region arrived in 1860. Game was abundant, and four years later there were no less than fourteen American ships on the spot. Soon after Scotch whalers followed. The year 1870 marks the height of the industry. Later decline set in, and since 1912 no whalers have wintered in Repulse Bay. The greater part of the Aiviliks and a number of the Udeleliks and Netchiliks entered the service of the whalers and under their tuition became excellent sailors. They abandoned the kayak for the whaling boat. As this requires a more numerous personnel than these weak tribes can provide, they do not engage in the hunt for marine mammals and hence do not secure sufficient oil to furnish their lamps in winter.

At the time when the courier left, Rasmussen had already started on his great journey which will lead him along the northern coasts of America to the northeastern coast of Siberia. He is accompanied by only one companion, one of the Eskimos brought from Cape York. Freuchen and Bangsted were preparing to explore the interior of Baffin Land, while Mathiassen was to devote himself to archeological work in the neighborhood of Chesterfield Inlet and studies of the Eskimos living here and at Fort Churchill. Birket-Smith was on the point of departure for continuation of his observations among the tribes in the interior of the Kazan River as far as Lake Ennadai.

CHARLES RABOT

WORLD AS A WHOLE AND LARGER PARTS

The Boundaries of Turkey According to the Treaty of Lausanne. If the Treaty of Lausanne signed July 24, 1923, is ratified by the contracting powers, the European boundary of Turkey will become definitively established. By the terms of the Treaty of Sèvres Turkey was all but eliminated from Europe, since she would have retained besides the city of Constantinople only a small tract of land immediately adjacent thereto. The Lausanne terms restore to Turkey the Thracian boundary of 1914 in all but a few minor details. The map (Fig. 1) shows the Lausanne line in Thrace, and by reference to the current volume of the *Geographical Review*, p. 128, the line of 1914 and other boundaries in Thrace may be traced. The Maritsa now forms the boundary from a point near Adrianople southward to the Aegean. Opposite Adrianople is the important railway station of Karagach. It becomes Turkish and thus gives Turkey immediate access upon her own territory to a section of railway that connects this important city (and former Turkish capital) with the present railway line between Bulgaria and Constantinople. Greece is excluded from eastern Thrace and from the coast of the Sea of Marmara after three years' occupation. Bulgaria's southern boundary is left unmodified in eastern Thrace. It stands as defined in the Treaty of Neuilly. An important feature of the Thracian boundary is the establish-

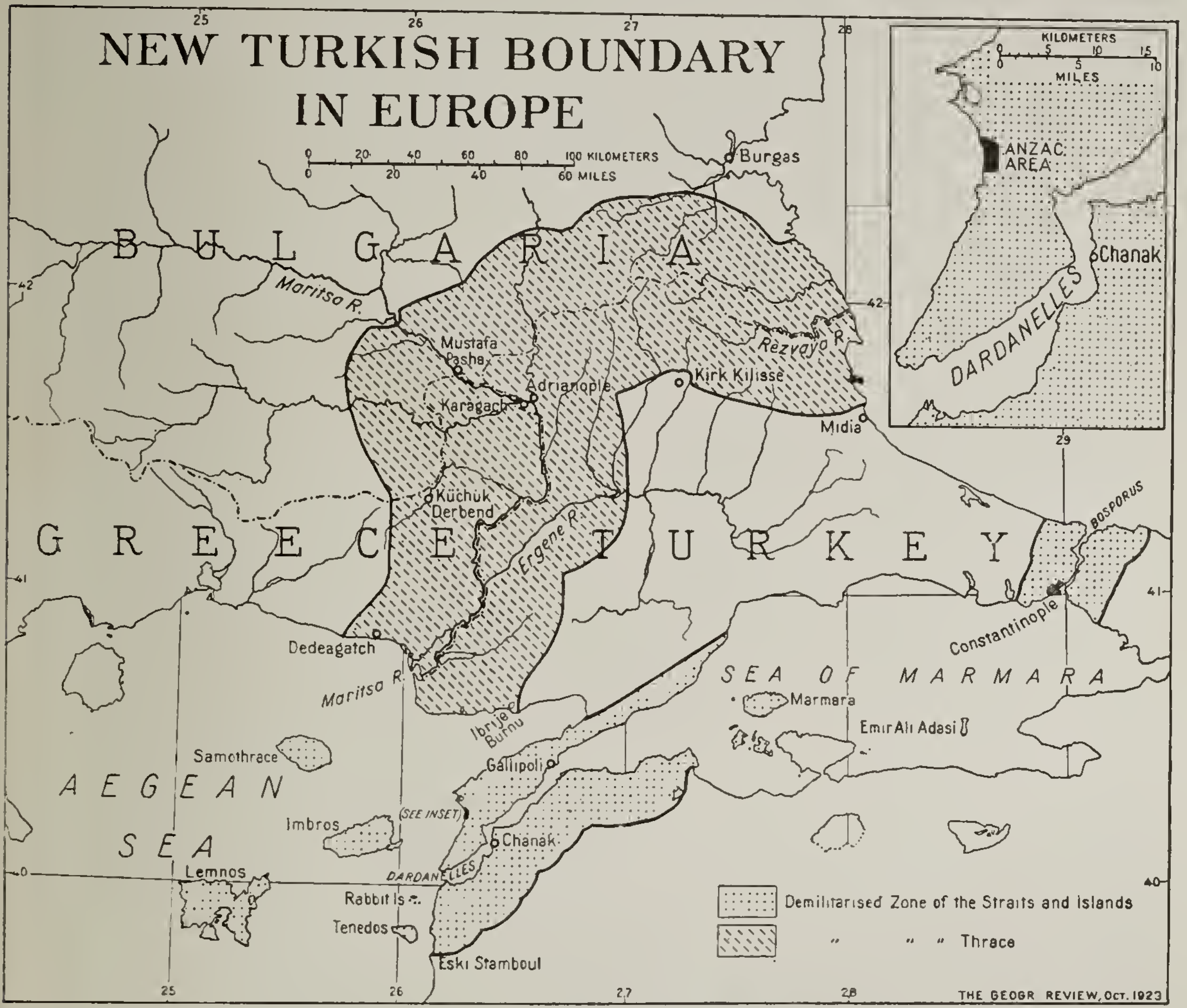

FIG. 1.—Map showing the European boundary of Turkey according to the Treaty of Lausanne (1923) and the demilitarized zones of Thrace and of the straits and islands. Scale 1: 3,750,000.

ment on either side of it of a demilitarized zone in which all fortifications shall be destroyed and no new ones erected. A similar demilitarized zone is established on either side of the Bosporus, the Dardanelles, and certain islands (see map, Fig. 1).

From the Mediterranean to the Persian frontier the boundary of Turkey is to run as described in Article 8 of the Franco-Turkish (Angora) Agreement of October 20, 1921. The boundary between Turkey and Iraq is to be laid down by friendly agreement to be concluded between Turkey and Great Britain within nine months from the date of ratification of the Treaty. In case of disagreement as to the location of the boundary, the question is to be referred to the League of Nations.

Certain islands of the Aegean, including the Dodecanese, are also definitely disposed of by the Treaty of Lausanne. The earlier agreements of 1913 and 1914 assigning to Greece certain islands, among them Lemnos, Samothrace, Mytilene, Chios, Samos, and Nikaria, are now confirmed subject only to the exception of those islands given to Italy by Article 15 of the present treaty. Italy obtains fourteen islands of the Dodecanese group and adjacent thereto. These include the important islands of Rhodes, Cos, Patmos, and Castellorizzo. Imbros and Tenedos are to be under Turkish sovereignty with guarantees for the non-Moslem population. Those islands that lie within three miles of the Turkish coast are to remain Turkish territory unless otherwise allotted. On the islands of Mytilene, Chios, Samos, and Nikaria, Greece is to establish no naval base and no fortifications, and her military contingents on these islands shall be limited to the normal number called up for military service on the spot.

Among the territorial provisions is one relating to a small area on the western side of the Gallipoli peninsula called the Anzac Area (Inset, Fig. 1) and granted in perpetuity to the British Empire, France, and Italy. Custodians appointed by these three powers will preserve the graves and cemeteries there; but Turkey controls access to the area, and it must not be built up or fortified in any way except in so far as houses are constructed for the sole use of the custodians.

Turkey renounces all rights and titles over Egypt and the Sudan as of November 5, 1914, and also recognizes the annexation of Cyprus as proclaimed by Great Britain on November 5, 1914. These provisions affect British title to the lands in question. The Italian title to Libya, gained as a result of the Italo-Turkish War of 1911–1912, is confirmed by an article which also abolishes even those rights and titles of Turkey in Libya which Turkey enjoyed under the treaty of October 18, 1912, at Lausanne, which closed that war. Turkey further recognizes and accepts the "frontiers" (boundaries) of Germany, Austria, Bulgaria, Greece, Hungary, Poland, Rumania, the Serb-Croat-Slovene State, and the Czecho-Slovak State, as laid down in the several treaties closing the World War and already described in earlier numbers of the *Geographical Review.* On account of the layout of Turkish territory in Europe and the course of the railroads upon which several Balkan nations must depend for through railway communication, the freedom-of-transit clauses of earlier treaties between the Allied Powers and the Central Powers are adhered to by Turkey, and likewise the earlier arrangements preceding the World War as determined at Berne and the conditions respecting international railways as laid down in the Conference of Barcelona of April 20, 1921.

It may be pointed out as a matter of geographical interest that all states which benefited by the Balkan Wars through the distribution of territory or that now benefit by the terms of the Treaty of Lausanne shall participate in the annual charges for the service of the Ottoman Public Debt. The nominal capital likewise shall be distributed on the same basis as the annual charges, i.e. according to the ratio between the "average total revenue" of the territory in question and the total revenue of the Ottoman Empire in 1910–1911 and 1911–1912.

In the field of economic geography, clauses relating to the freedom of the Dardanelles, the Sea of Marmara, and the Bosporus are particularly interesting. These waterways are declared free to transit and navigation by sea and air for every ship no matter what its flag or cargo, and there is to be no tax or charge except for services directly rendered. Both shores of the Straits of the Dardanelles and the Bosporus are to be demilitarized. There are specific provisions for the use of these waterways in a "time of war, Turkey being neutral," a "time of war, Turkey being a belligerent," and so on. If Turkey is neutral in time of war, the conditions for the use of the Straits are the same as in peace. No power may send through the Straits a force greater than the most powerful fleet of any littoral power bordering on the Black Sea. If Turkey is a belligerent she may prevent enemy vessels from using the Straits, but neutrals may pass. The extent to which commerce will be free and the terms of the treaty faithfully carried out will soon be tested, for certain Turkish warships and material are to be returned to Turkey, and the Allies have agreed to complete their evacuation of the zone of the Straits within six weeks of the date of ratification of the treaty.

PHYSICAL GEOGRAPHY

River Meanders and Meandering Valleys. Because of the approach to a geometrical path made by river and stream meanders, attempts have been made to treat the flow of meandering rivers in a mathematical manner. A helpful contribution of this kind was made some years ago by Professor J. J. (now Sir Joseph) Thomson, who showed that the slightly greater vertical pressure exerted by the fast-moving surface water on the outside of a curve, where it is a little raised by centrifugal force, will push the slower-moving bottom water, which has a less centrifugal force, toward the inside of the curve; and thus detritus swept from a concave bank will be drifted obliquely across the channel bed toward a convex bank.

A less successful effort to formulate the theory of river meanders was made four years ago by F. M. Exner, physicist in Vienna ("Zur Theorie der Flussmäander," *Sitzungsbe Akad. der Wiss. in Wien, Mathem.-naturw. Klasse*, Vol. 128, 1919, pp. 1453–1473). He assumed in the first place that the serpentine flow of a continuous river current is analogous to the oscillatory movement of a single ball rolling down a gently inclined trough of concave cross section; but the lateral component of the ball's motion is retarded by an opposed component of gravity whenever the ball moves away from the axial line of the trough in its curved rolling, and there is no similar retarding force in the case of a meandering river; it has a fairly uniform gravitative acceleration all along its curved channel. And the flow of a river, in which each part must follow its leader is not closely analogous to that of a single ball which rolls where it pleases. Exner also argued that the enlargement of meander curves, which commonly takes place in flood plains, is accompanied by an increase in meander length; that is in the distance from one curve apex to the next on the same side of the valley. But this would involve an enormous down-valley shifting of the down stream curves by erosion, and no such great shifting takes place in nature. As meanders grow, the distance from curve to curve remains practically constant; if it did not, cut-offs would not be produced. A third error is introduced in his experimental illustration of meander formation by the action of a stream fed from a faucet fixed at right angles to the gentle slant of a sand-and-clay-covered board, down which the stream is to erode its channel. The exaggerated curve formed opposite the faucet not only remains fixed instead of migrating down valley but is succeeded by rapidly diminishing curves down stream, thus suggesting that the slant of the board was too great to favor the development of so strong a meander curve as was imposed by the faucet. In actual rivers, where meanders are increasingly developed the flatter the flood plains, the meanders are not fixed, and no persistent downstream diminution of meander pattern is ordinarily found.

Exner now contributes another mathematical paper on detrital slopes and mountain forms ("Über Schuttböschungen und Bergformen," *Geografiska Annaler*, Vol. 5, 1923, pp. 59–71) in which loose sand is heaped up to its "angle of repose" on cardboard bases of various patterns, thus producing forms which imitate graded mountains and which are subjected to analysis. It is thus shown that the slanting edge between adjacent slopes, the rectilinear bases of which make a salient angle at their junction, will be the more rounded the larger the basal angle; and this explains, to those who did not know it before, why the upper contour lines of a graded hill become rounded even if the hill base has a somewhat angular pattern. The demonstration is ingenious, but it is not physiographically satisfying, in that it applies only to an arbitrarily selected and empirically produced phase of a changing form and gives no adequate consideration to earlier and later phases or to the flow of change by which they are connected.

Meandering valleys are here again encountered in two illustrations, each of which shows a pair of ridges enclosing such a valley, one with moderate, the other with strong meanders. But the valleys are not reasonably developed; they are arbitrarily imitated by slits cut in the cardboard bases, so that the excess of heaped-up sand is disposed of by falling through the slits instead of by being swept down the valleys. Naturally therefore, the resulting forms fail to show the unlike slopes on the up-valley and down-valley sides of the meander spurs. All experiments of this kind have a greater illustrative than demonstrative value.

An inductive study of certain meandering valleys in England has lately been published by A. M. Davies, in which a number of cut-off meander curves are described in detail ("The Abandonment of Entrenched Meanders: Wye, Evenlode, Cherwell, Thames," *Proc. Geologists' Assn.*, Vol. 34, Part 2, 1923, pp. 81–96). He calls the cut-off spur end "the meander core" and suggests the names "reversed stream valley," "drop hanging meander valley," and "deepened residual meander valley" for the three parts into which an abandoned curve is usually subdivided in relation to the little streams that still follow it. Statement might be added to the effect that the division of the curve into these parts is often largely determined by detrital fans formed on the curve floor by small inflowing streams, after the main river was withdrawn from it.

W. M. Davis

HISTORY OF GEOGRAPHY

Recent Studies in Medieval Moslem Geography. Those very centuries of the Middle Ages when scientific learning was most neglected in Western Europe were the brightest ages of Moslem science and literature. Baron Carra de Vaux is endeavoring to characterize the leading achievements of Moslem thought during this period in a work of five volumes now appearing under the title "Les Penseurs de l'Islam" (Paris, 1921—). Avowedly a work of popularization this is, none the less, one which is based upon a solid foundation of critical research. The first three chapters of the second volume constitute a study of the Moslem geographers. J. T. Reinaud's famous treatise on the geography of the Orientals forming the first volume of his "Géographie d'Aboulféda" (Paris, 1848) is still a classic in this field, and Joachim Lelewel's learned but remarkably confusing "Géographie du moyen âge" (4 vols. and epilogue, Paris, 1852–57) revealed much that was new at the time of publication. But as both of these have long been out of date, for many years a growing need has been felt for just such a discussion as is furnished in Baron de Vaux's succinct and well-written chapters. The comprehensive scope of his scheme as a whole, however, has permitted the author to devote only a hundred pages to Moslem geography. Consequently and of necessity many matters have been omitted that would be of great interest to the student of the history of geography, had only the compass of the treatment permitted their discussion. That some of these omissions are mentioned in the present note should not be construed as reflecting adverse criticism upon de Vaux's chapters but merely as embodying suggestions for those who may wish to investigate Moslem geography beyond the range of his valuable introduction to the subject.

Baron de Vaux deals with three main topics. In the first place he briefly characterizes certain of those bulky descriptive compilations of geographical information which were so typical of Arabic scholarship, the writings of men like Ibn Khordādhbeh, Idrīsī (or Edrisi), Abū-l-fidā, and Yāqūt. He then turns to the more complex subject of geographical theory and closes with an account of some of the principal voyages and travels. References in the footnotes direct the reader to the sources and to a few of the more important secondary studies.

The Moslems owed much to Greek science. On the whole, comparatively little originality is apparent in their geographical theory, though some points of detail were elaborated by them more extensively than had been done by their predecessors of antiquity. In the field of mathematical geography, for instance, Islam placed special demands upon Moslem scientists. The necessity for the orientation of mosques in the direction of Mecca required the most precise possible determination of positions.

Moslem effort in this direction was inspired largely by Ptolemy. At the outset of his first chapter Baron de Vaux calls attention to the fact that at an early date the Mohammedans became familiar with Ptolemy's "Geography." He does not, however, embark upon the consideration of the vexed problem of the relation of the figures for latitude and longitude found in Khwārizmī's "Kitāb sūrat-al-ardh" to the original Ptolemaic figures nor of the light which this work and the works of other Moslem writers (notably Al-Battānī) may (or may not) throw upon the question of the Ptolemaic maps. The only known manuscript of the "Kitāb-sūrat-al-ardh" was discovered in Cairo in 1878. Edited by C. A. Nallino in 1894 (*Atti. Reale Accademia dei Lincei*, Ser. 5, Classe di scienze mor., stor., e filol., Vol. 2, Part I, Memorie) it has recently been made the object of the more critical and definitive researches of Hans von Mzik (see *Mitt. K. K. Geogr. Gesell. in Wien*, Vol. 58, 1915, pp. 152–176). Von Mzik has also edited the portion which deals with Africa ("Africa nach der arabischen Bearbeitung der Γεωγραφικὴ ὑήφγησις des Claudius Ptolemaeus von Muhammad ibn Mūsā al-Hwārizmī," *Denkschriften Kaiserl. Akad. des Wiss. in Wien, Phil.-hist. Klasse*, Vol. 59, Part IV, 1916) with a copious commentary which should form a fundamental work of reference on Moslem place names in and geographical knowledge of that continent.

Baron de Vaux's very brief discussion of Moslem methods of determining geographical co-ordinates may be supplemented by referring to Schoy's monographs on the subject. Schoy's doctoral dissertation on the historical development of means of finding latitude (Carl Schoy: Die geschichtliche Entwicklung der Polhöhenbestimmungen bei den älteren Völkern, Munich, 1911) contains detailed analyses of the methods of Al-Battānī, Ibn Yūnus, and Abū-l-Hasan; and other Mohammedan methods are treated by the same writer in *Annal. der Hydrogr. und Marit. Meteorol.*, Vol. 49, 1921, pp. 124–133; Vol. 50, 1922, pp. 3–20. The more difficult matter of longitudes is discussed by Schoy in *Mitt. K. K. Geogr. Gesell. in Wien*, Vol. 58, 1915, pp. 27–62.

Among the "cosmographers," or writers on physical geography in its widest sense, Baron de Vaux mentions especially Kazwīnī and Dimashqī. From the former, who lived in the thirteenth century of our era, he cites some very striking passages on geomorphological processes. Kazwīnī believed that alluvial deposits were solidified by the heat of the sun into rock and were then raised on high by earthquakes. Thus mountains were formed. He well understood the forces of erosion upon mountain summits and their power to reduce the heights to a level. He describes in terms that might well stand in modern textbooks of geology the wearing of fragments from the crests of hills and their deposition, layer by layer, in the depths of lakes. He attributed the crumbling away of the peaks to the drying of mountain summits by the prolonged action of the rays of sun, moon, and stars. In the arid climate of the Nearer East the processes of weathering and erosion are much more obvious than in humid Europe and were hence noted with greater precision by Oriental observers like Kazwīnī or the Persian Hamd-Allāh Mustawfī (see *Geogr. Rev.*, Vol. 11, 1921, pp. 457–458) than by their contemporaries of the Western World. Kazwīnī infers from these processes that under the changing celestial influences that must accompany the precession of the equinoxes there will inevitably take place an interchange of habitable areas upon the earth's surface: "habitable regions will become desert and deserts habitable." This theory had its roots in the astrological lore of antiquity. Baron de Vaux does not allude to a remarkable elaboration of it, as set forth in a great encyclopedic work produced in the tenth century after Christ by the philosophical school known as the "Brothers of Piety and Sincerity." Here gradual alterations of the relative positions of land, seas, mountains, steppes, lakes, rivers, deserts, and other topographic features are prophesied and attributed to stellar causes. Nor does Baron de Vaux allude to an even more interesting rationalistic argument against the possibility of such changes to be found in an anonymous treatise translated from the Arabic into Latin in the Middle Ages and falsely ascribed to Aristotle (see Pierre Duhem; Le système du monde, Vol. 2, Paris, 1914, pp. 214–228). Incidentally it may be remarked that the encyclopedia of the "Brothers of Piety and Sincerity" (translated into German in Friedrich Dieterici's, "Die Philosophie der Araber im IX und X Jahrhundert n. Chr.," Vol. 5, Leipzig, 1876) contains significant meteorological lore which may be used to supplement de Vaux's somewhat inadequate treatment of Moslem meteorology (pp. 250–252) based on Kazwīnī alone. German translations of the meteorological passages from the encyclopedia of the "Brothers" and from Kazwīnī, may conveniently be found in "Denkmäler Mittelalterlicher Meteorologie" (*Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus*, edited by G. Hellmann, No. 15), Berlin, 1914, pp. 23–41, 127–142.

From among the admirably selected materials which Baron de Vaux has gathered together in his second and third chapters dealing with Moslem records of exploration, sailors' tales, pilot books, and with the monumental travels of Ibn Jubair and Ibn Batūtah we may mention in conclusion an unusual passage from Al-Bīrūnī which reveals a genuine feeling for the picturesque in landscape. The Arab traveler describes thus a view from a high point in the Himalaya: "From the height of this mountain India appeared like a dark expanse beneath the mist, the mountains at the base of the peak giving the effect of little hills; Tibet presented a ruddy appearance."

METHODOLOGY

On the Definition, Method, and Classification of Geography. Under this title Dr. Sten De Geer makes a contribution to the perennially interesting subject of the definition and scope of geography (*Geogr. Annaler*, Vol. 5, 1923, pp. 1–37). Dr. De Geer's amplified definition runs thus: "Geography is the science of the present-day distribution phenomena on the surface of the earth. It aims at a comparative and explanatory description of the characteristic complexes of important distribution phenomena—geographical provinces and regions—which occur on the earth's surface." In his insistence on distribution phenomena as the *real objects* of geography Dr. De Geer is in close agreement with Dr. Hogarth, who in his British Association address on "Applied Geography" (*Scottish Geogr. Mag.*, Vol. 38, 1922, pp. 10–19) states that "the study of distribution, rightly understood, is the whole essential function of geography."

The Swedish geographer's views on the needs and character of distributional studies are elaborated in the following pages which deal with "the method of studying the general phenomena of distribution." The first aim is to trace the limits of area of distributions, the second to determine the intensity or density of distribution, including a time or duration factor (increase, diminution, movement). Obviously such a method must have the closest relation to map work. Dr. De Geer deplores the backward state of cartography and envisages the type of "all-embracing synthetic geographical map" which has not yet been created.

Passing thence from the general to the particular Dr. De Geer arrives at a classification of geography, taking up the usual twofold division into "General" and "Regional." The term "General" he finds misleading and would substitute for it "Planetary." His five major subdivisions under this head are the Atmosphere, or Air Envelope; the Hydrosphere, or Water Envelope; the Lithosphere, or Crust of the Earth; the Biosphere or Strata of Life Forms; the Anthroposphere, or the Human Stratum. A sixth division deals with the theory, technique, nomenclature, and history of geography. The regional classification, which is shown on a map, includes 27 terrestrial divisions (Eurasia, 9; Africa, 5; North America, 5; South America, 3; Antarctica, 2; Australasia, 3) and 17 maritime divisions. Here again, as in defining the scope of geography, Dr. De Geer insists on the abstract quality of the phenomena studied, whence the science is "completely definable and independent in its limits and method."

GEOGRAPHICAL NEWS

Practical Hints to Scientific Travellers. Under this title Dr. H. A. Brouwer, Professor of Geology at the Technical University of Delft, has initiated a series of practical guides which will be warmly welcomed by scientific travelers generally. So far as the writer is aware, the field has not before been occupied for countries where the methods of the traveler lie between those of the explorer and the tourist. Professor Brouwer is, by reason of his wide experience and his knowledge of English, well qualified to edit the series and has shown good judgment in the selection of writers for the opening number. It contains three papers, one by Brouwer and N. W. Easton on the Dutch East Indies, a second by P. A. Wagner and T. G. Trevor on South and East Africa, and a third by Warren D. Smith on the Philippines.

Each main region is to be described by an authority, and in this way the most practical suggestions are worked into the text. In Dr. Brouwer's own paper are given the names of institutions interested in the region, the manner of taking specimens and notes, the exact character of the outfit, the lines and methods of communication, currency, servants, food, packing, camping, and costs. It is not intended that each number shall conform to a rigid scheme; on the contrary each author may develop his subject in such a way that important matters are brought into the foreground.

The papers of the series have naturally a direct interest only to that small number of men who intend to travel in the regions treated, though there are many suggestions which will be useful for carrying over into other districts. The way in which the World War has transformed methods of approach is prominently brought out. This is notably true as respects the enlarged use of motor car and airplane and in the application of aerial photography.

W. H. Hobbs

OBITUARY

COUNT F. DE MONTESSUS DE BALLORE. Count F. de Montessus de Ballore, born in France in 1851, died in the early spring of this year in Santiago, Chile. The distinguished seismologist received the first impulse towards what became his life work while acting as chief of a French military mission to the republic of Salvador in 1879. An early result was the publication of "Temblores y erupciones volcánicas en Centro-América" (1884). His work was preëminently based on geographical method. With painstaking care he assembled a catalogue of over 170,000 earthquakes. By mapping these (nearly 160,000 were used in preparation of his seismic map of the world) and correlating with the regional geology he was able to formulate important laws on the geographical distribution and origin of earthquakes. The results were given in a classic work, "Les tremblements de terre: Géographie séismologique", published in 1906 and supplemented a year later by "La science séismologique: Les tremblements de terre," in which the nature and character of earthquakes were discussed as physical phenomena. It may be of interest to recall the statement of his fundamental law. "The earth's crust trembles almost equally and almost solely along two narrow zones which lie along two great circles . . . the Mediterranean, or Alpine-Caucasian-Himalayan (53.54 per cent of the seismic disturbances), and the Circumpacific or Ando-Japanese-Malayan (41.08 per cent). These two zones coincide with the two most important lines of relief on the earth's surface" (Les tremblements de terre, p. 24). The geological interpretation adds that these zones coincide with the geosynclines of the Secondary period; hence "the geosynclines (the most unstable bands of the earth's surface) where great thicknesses of sediments have been intensely folded, dislocated, and elevated during the Tertiary period when the principal mountain chains (geanticlines) of the present were in formation include, with two or three doubtful exceptions, all the seismic regions." (The last two words of the definition have reference to de Montessus de Ballore's classification of regions as seismic, peneseismic, and aseismic.) Called to Chile in 1907 he founded the Seismological Service of that country, acting as its director until his death. His publications during this period include "Historia sísmica de los Andes" (1911–1916) and "Bibliografía general de temblores y terremotes" (published in the *Revista Chilena de Historia y Geografía*). A detailed obituary notice appeared in *Iberica* for May 5, 1923.

RAPHAEL PUMPELLY. Dr. Raphael Pumpelly, corresponding member of the American Geographical Society and member of the Association of American Geographers, died at Newport, R. I., on August 10, aged 87 years. His long life was devoted to geological and geographical study and exploration in many lands. Early in his career he traveled extensively in Asia, conducting scientific investigations for the Japanese Government and later exploring in central, western, and northern China and Mongolia, the results of which appeared as "Geological Researches in China, Mongolia, and Japan," 1888. In America he engaged in investigations for state and federal geological surveys, his labors here including the discovery of some of the economically important iron ore deposits of Michigan and the directing of the mineral industries survey for the tenth census. The greatest geographical interest attaches to his work as leader of the Carnegie Institution's expedition of 1903 to Central Asia, in which associated with him were his son Raphael W. Pumpelly, Professor W. M. Davis, and Ellsworth Huntington. The results of the expedition were published as "Explorations in Turkestan, With an Account of the Basin of Eastern Persia and Sistan" (1905). The great scope of Dr. Pumpelly's work has been well described autobiographically in the two volumes of his "Reminiscences," 1918 (reviewed in the *Geogr. Rev.*, Vol. 7, 1919, p. 64).

GEOGRAPHICAL REVIEWS

BRAZILIAN AMAZONIA

PAUL LE COINTE. **L'Amazonie brésilienne: Le pays—ses habitants, ses ressources, notes et statistiques jusqu'en 1920.** Vol. 1, 528 pp.; ills.; Vol. 2, 495 pp.; map, ills., bibliogr. Augustin Challamel, Paris, 1922. 70 fr. 10 x 7 inches.

Here we have a first-class work of encyclopedic proportions and character. While it abounds in reliable information of all kinds required by students of geography, it may be stated at the outset that "L'Amazonie brésilienne" is not a work upon regional geography as now understood, nor does it include even a single chapter, such as geographers will look for eagerly, containing a summary of conclusions and setting forth the relationships of the regional elements. In one other major aspect the work is disappointing to a geographer, who would be led from knowledge of the author's excellent cartographic work previously published to expect this book to be accompanied with a scientifically compiled map of Amazonia. But the map contained in Volume 2, in scale about 1:10,000,000, while it is well printed, leaves much to be desired as a compilation.

Apart from these criticisms, however, this monumental work is of immense value to serious students. The author from his long residence in the country and from the scientific manner in which he approaches his great task will command the respect of his readers. The book is especially valuable for its frequent discussions of the causes of economic backwardness and even more so for the author's numerous suggestions of the action required to regenerate the industries of Amazonia.

Volume 1 opens with a short account of the discovery and exploration together with a description of the present political boundaries. This is followed by three descriptive chapters dealing respectively with the Upper and Middle Amazon, the Lower Amazon, and the principal tributaries. These chapters both lose and gain from being written somewhat after the manner of a Baedeker's guidebook; but they contain much that is valuable and interesting. This is especially true in respect to the authoritative statement of river nomenclature, the physical characteristics and size of the various rivers, and the facts of navigation. In passing, it may be noted that many astronomical positions are mentioned. It would appear useless to state these in any South American country unless they are accompanied by a note as to their source and reliability. From the author's descriptions of towns an excellent idea will be obtained of the inadequacy of government in Amazonia. The third of these chapters contains an excellent short account of the physical geography of the region—of the importance of slight differences in altitude in relation to the annual variations in water level as leading to different soil and vegetation types.

The short chapter on climate is perhaps as complete as the data merit, and it contains interesting matter regarding the relations of climate to the regimen of the rivers on the one hand and to health and disease on the other. It is somewhat bewildering to the nonresident to read of winter and summer in this equatorial region; but, as the author explains, "winter" in the local usage is the rainy season (p. 193). Twenty-two pages are devoted to races and population, and they contain a good summary of Indian characteristics, largely made up of quotations from observers deemed the best qualified to appraise them.

This virtually concludes the physical and general part of the work. The remainder—half of Volume 1 and all of Volume 2—treats of economic and special aspects.

A chapter on navigation consists of particulars of the shipping—ocean-going, river, and coastwise—companies, tonnage, and freight statistics being given.

The economic development of Amazonia is treated in a chapter reprinted from an interesting paper published by the author in 1904(Développement économique de l'Amazonie, *Bull. Soc. de Géogr. Commerc. de Paris*, Vol. 26, 1904, p. 472) which places the beginning of the modern development in 1867 when the Amazon was opened to international trade, the most important event thereafter being the influx of laborers from the population of Ceará and Rio Grande do Norte ruined by droughts between 1877 and 1880. From that date onwards the history is of course largely the story of rubber; and it sets forth in a general way the facts of futile governmental efforts at fostering the industry with a controlled immigration and settlement and inadequate improvements of communications—features which are more fully dealt with in later sections. Perhaps the most pregnant sentence in the book is the apparent paradox enunciated in this chapter, that the greatest hindrance to Amazonian development is the fact that the region contains immense riches in natural and easily exploitable products.

The discussion of the extractive industries occupies 223 pages, of which 103 are given to rubber (*Hevea brasiliensis*), while 51 pages are devoted to forestry and lumbering. It would seem that these sections leave nothing to be desired. All the aspects of each question are dealt with—botanical, historical, economic, and social. The discussion of the rubber industry in particular is a real contribution to the literature of the subject. In this the author is necessarily led to a careful comparison of the industry as practiced in Amazonia and in the plantations of southeastern Asia. Without going in detail into the arguments adduced, which are supported by many statistics, it may be said that the author does not hold the case of the Amazon rubber industry to be hopeless in the face of the more scientific and heavily capitalized industry of the British and Dutch possessions; but he has no hesitation in condemning the methods of saving the rubber situation from complete ruin as they have been put in operation. Nevertheless, he approves of many of the measures as proposed and has added his own practical suggestions. Among the other products discussed in this class are castanha (Brazil nut), copaiba, coumarou (tonka-bean), andiroba, sarsaparilla, guarana, various vegetable oils and gums, fibers, tanin products, dyeing, medicinal and aromatic plants.

Volume 2 opens with a vivid description of the forest and of life in it, which is followed by technical information regarding over two hundred valuable species or groups of species. The exportation of lumber is still small though increasing fast, and the strange import of pine planks from the United States, from which all the rubber cases were made until a few years ago, has now ceased. The author hopes that measures will be taken to stop the wasteful destruction of valuable timber, especially by the planter, who progresses from patch to patch taking two or three crops from each and destroying the forest as he goes.

Stock raising is discussed in 47 pages, which contain much information not easily accessible. At the present time there are two areas supporting large herds of cattle and important numbers of horses—the island of Marajó and the campos of the upper Rio Branco. In the latter region stock might be greatly increased but for the difficulty of access and the impossibility of navigating the Rio Branco. The *varzea*, alluvial land bordering the great rivers, is covered in the dry season by luxuriant pasture which could support very large herds; but cattle raising in these localities cannot progress, for in the flood season the refuges with a food supply are almost insignificant and the cattle perish from drowning, disease, or as the prey of crocodiles and even of a voracious fish—the *piranha*. The author gives good reasons for his statement that no good wet weather pasture can be found or created in the vicinity of the main rivers. In the absence of major cattle developments elsewhere, however, and in view of the high prices to be realized it is well worth while to do all that is possible to conserve the herds by hand feeding and by clearing timber from the higher parts of the *varzeas* themselves to make larger refuges. The country away from the main rivers, on the other hand, is eminently suited for cattle raising on a large scale. One of the first great areas to be developed should be the Campos Geraes extending from the frontier of Dutch Guiana southwards to within 300 kilometers of the Amazon. This region would be penetrated by gradually pushing self-supporting agricultural colonies furnished with a light railroad northward from Obidos. The line of approach which the author describes is particularly rich in forest products; and, while much land is suited to tropical agriculture, other areas—as the campos of the Ariramba—would form fine land for sheep and goats. Other huge areas of cattle pasture are known to exist between the great southern tributaries of the Amazon. But for the exploitation of these the author has no immediate plan to propose. It is evident that there is a score of ways in which the owners of cattle might greatly improve their own condition by showing more initiative in tending their animals and in improving the stock.

A chapter on agriculture occupies 143 pages. Having read in its opening passages a vivid description of the difficulties confronting the Amazonian planter, of the countless foes both animal and vegetable which he must defeat, and of the uncertainty of being able to market his produce, one is astonished that any crop is successfully raised and harvested in spite of the undoubted fertility of the soil. Of all the obstacles the worst is the lack of a market for the fruits of that varied agriculture which has been urged as the solution of Amazonia's problem.

M. Le Cointe, then, presses strongly the view that the future of the country must rest upon the cultivation on a large scale of a few plants—mainly rubber and cacao—native in Amazonia and yielding crops of high intrinsic value and destined for export. The only land immediately cultivable is that of the alluvial strips of the *varzeas*—of great extent, however, in the aggregate; here the annual flood ruins all crops otherwise suitable save the two cited, and of these the former alone can stand prolonged immersion. But above all the Amazonian planter must take to scientific methods, and the government must introduce him to them in a systematic manner. The technique of cacao cultivation is here treated at some length, while other crops receiving attention according to their importance are tobacco, sugar, rice, maize, bananas, cotton, coffee, indigo, coconut, and various dye- and oil-producing plants, edible fruits, etc.

The remainder of the work comprises a systematic account of the fauna of Amazonia (130 pages), a statistical chapter on general commerce and finance, and short sections on mining and manufactures, native industries, posts and telegraphs, advice to the traveler upon hygiene, landownership regulations, and a bibliography of nearly 200 titles.

Geology of the Oil-Fields Region of Northern Peru

T. O. Bosworth. **Geology of the Tertiary and Quaternary Periods in the North-West Part of Peru.** With an Account of the Palaeontology by Henry Woods, T. Wayland Vaughan, J. A. Cushman, and others. xxii and 434 pp.; maps, diagrs., ills., index. Macmillan & Co., Ltd., London, 1922. $11.25. 9 x 6 inches.

A considerable amount of geographical material is scattered through this book, but, as the title indicates, it has a geological organization; and there is some difficulty in bringing the geographical matter together, though the analytical index partly offsets this deficiency. The treatment of the geographical material is largely empirical, and the sources are indicated in only a few cases. Though there is no systematic account of the physiography, there is presented sufficient detail for such a treatment of the 4000 square miles of territory in northwestern Peru with which the book deals. While there are explanations of processes and forms they are scattered and subsidiary to the geology, and both the physiography in some cases and the geographical material in almost all cases are presented as assertions rather than as discussions; for example, "After passing Cabo Blanco, it [the Humboldt Current] begins to swerve seaward, due to the warm Ecuador current, which is bearing down against it from the north" (p. 272). On the same page the explanation of desert conditions makes the existence of a desert condition the *cause* of a continuance of desert conditions. While self-stimulation is a factor, it is of course not the chief one. One wonders if the author's experience and the records of the oil companies at Lobitos and elsewhere could not supply specific data about rainfall, mist, and the like, instead of general statements like this: "There has been no considerable rain for about thirty years" (p. 275). To be particularly commended is Part IV, Chapter 4, on the work of the wind in the desert, with its original drawings to illustrate the formation of dunes and their movement. The statement is made on page 259 that " . . . on the floors of some of the valleys, footprints, made nearly thirty years ago, are still intact". One would like to know the nature of the proof of so interesting an observation. More important is the statement that the newest of the uplifted land on the coast, only a foot or two above the high-tide level, "was under cultivation in the days of the Incas" (p. 259). The author employs this statement to reinforce his argument that the last five hundred years represent but a ten-thousandth part of Quaternary history. How is it known that the cultivation referred to really occurred in the days of the Incas, and how is it known that there may not have been considerable uplift and subsequent depression in the past five hundred years?

Folder IV, the geological map, and Folder IX, the general map, show a regrettable lack of correspondence in topographical detail. The Punta de Payta, for example, is of remarkably different form on the two maps; and on neither is it like the outline of the Admiralty chart. The Quebradas Ancha and Honda are unlike on the two maps, and the relief on Folder IX is very sketchily indicated. The value of the maps as a reliable contribution to the cartography of a poorly mapped part of Peru is thus greatly diminished.

There are more than one hundred and fifty illustrations, which include photographs of Lobitos Bay, Talara Harbor, Negritos and Negritos Bay, the several oil fields, characteristic vegetation of the ravines and of the Amotape Mountains, the terrace topography, and many other features. Of particular interest are Figures 39 and 40, showing the benched character of the low coastal belt, the raised sea cliffs and beaches twelve miles inland, still fresh, though the old sea cliff, 100 to 120 feet high, is now 250 to 400 feet (measured from its base) above the sea. The present surface between the western border of the Andes and the Pacific is covered in large part by flat-lying sediments of Pleistocene age which were deposited on deformed and deeply eroded Tertiary beds. The latter were faulted and tilted in the coastal belt when the Pacific floor was dropped down to its present great depth. The faulting is reflected in the relief in many places where the Tertiary beds project through the covering of Pleistocene material or have been exposed by erosion of the Pleistocene cover.

The Eastern Front of the Andes

K. C. Heald and K. F. Mather. **Reconnaissance of the Eastern Andes Between Cochabamba and Santa Cruz, Bolivia.** Map, ills. *Bull. Geol. Soc. of Amer.*, Vol. 33, 1922, pp. 553–570.

K. F. Mather. **Front Ranges of the Andes Between Santa Cruz, Bolivia, and Embarcacion, Argentina.** Maps, ills., bibliogr. *Bull. Geol. Soc. of Amer.*, Vol. 33, 1922, pp. 703–764.

These two papers deal with the geology—stratigraphy and structure—of the regions described by Dr. Mather in the articles "Exploration in the Land of the Yuracarés, Eastern Bolivia" and "Along the Andean Front in Southeastern Bolivia" in the *Geographical Review*, Vol. 12, pp. 42–56 and 358–374 respectively.

A Map of the Amazon Basin

Map of the Amazon River Plain, as extending from the sea to the limits of free navigation for launches in flood season. Compiled and dedicated to the eventual spread of the gospel over the region named, by Rev. O. R. Walkey, 1922. Drawn on Mercator's Projection with equatorial scale 1:1,460,000 (1 inch = 23 statute miles, or 37 kilometers) and reproduced photographically in nine sheets and a sheet given to a table of distances.

This map in many ways is a very remarkable document. It is unique in the great amount of information it contains as regards the river courses, their names and their navigability, as well as the times necessary to traverse the streams and the trails which connect them; in the wealth of tribal names, place names, and settlements located; and in the character of the inset maps—on various scales—tables, and graphs such as those showing the mean depths of rivers for every month.

The map has evidently been scientifically compiled with great care and with much personal knowledge. A large number of documents has evidently been used and a considerable list of authorities appears under the title. It is greatly to be regretted that this map, presumably from lack of funds, had to be completely drawn by the compiler himself and that it has not been printed. For the appearance of the sheets detracts considerably from their general value, and the map undoubtedly merits a better fate. However, the river courses themselves are well drawn, and, while the hachuring is crude, the names, even the smallest, are nearly always legible. The reason for the adoption of Mercator's Projection is not clear; but in these latitudes the difference between this and other projections is of course not great. If, as is to be hoped, means will be found to have the map redrawn and printed so that it may become more generally accessible, two additions might perhaps be considered. In the first place the scientific value of the map would be enhanced by a brief statement of the method of compilation containing some discussion of the astronomical observations accepted and rejected. And, secondly, the introduction of a new category of stream line seems to be called for, to represent rivers which have not been surveyed instrumentally but have been traversed by intelligent persons. In the present edition there are few streams shown by broken lines; and a great many smaller rivers which appear as continuous lines are obviously not so accurately known as the larger rivers.

Photographic copies of Mr. Walkey's map may be obtained from W. F. Stanley & Co. (13, Railway Approach, London Bridge, S. E.) for £2 the set, and arrangements have been made to supply copies hand colored (for £3 5s.) to emphasize the political divisions

THE SWEDISH TOURING CLUB'S ATLAS OF SWEDEN

Svenska Turistföreningens Atlas över Sverige, Part I. 10 maps. Kartografiska Institutet, Stockholm, [1923]. 8½ x 5½ inches.

The Swedish Touring Club's Atlas of Sweden is the finest locational atlas of a country that the present writer knows. It excels in fullness of information on a fairly large scale (1:1,000,000), in clearness of expression, in artistic beauty, and in remarkable convenience of form. The finished work will apparently make a little book of 60 octavo pages, 5½ by 8½ inches, beautifully produced on heavy paper, the index making a moderate addition to its thickness. The main map of the country is to be in 19 sheets, of which 9½ are included in the first part now issued. The sheets overlap generously so there is no difficulty in following routes from one sheet to another. An admirable key map opens the work. The shade of blue selected for the sea is unusual, agreeable, and artistic. So is the soft gray used so much on land, e. g. to indicate forests and uncultivated land. This gray does not at all interfere with the legibility of the overprinted names, and it does agreeably set off the vermilion used for province names and boundaries and for the town symbols. Relief is rather hinted at than expressed by brown shadow lines, but these are very suggestive. Everything in the design of the map evidences knowledge of cartography and consciousness of the need of restraint if the map is to be eloquent rather then garrulous.

The base of the map appears to be the Swedish General Staff map, which probably accounts for the use of Stockholm for the zero of longitude. This is regrettable in the twentieth century. A society capable of producing so remarkable an achievement as this atlas has surely too broad a conception of patriotism to insist on the use of a local meridian, especially as the maps are so convenient that they are bound to have much use for general reference. Help in bringing the data of the staff map up to date has been given by 2000 correspondents, answering a questionnaire with regard to their localities.

The first plate is an admirable map of "Norden," the Scandinavian countries, including Finland, as is Swedish habit. Its scale, 1:8,000,000, allows an excellent presentation of the broader geography of the region including such characteristic but unfamiliar facts as the course of the Norwegian coast steamers inside the islands of the west coast. This is the only map in the series to use the meridian of Greenwich. It has relief by layer tints at 100, 500, and 1000 meters above and below sea level. Sheet 2 is a general map of Sweden, 1:4,000,000, showing chief towns and lines of communication. The present set of maps—about a third of the whole—is not, I understand, on separate sale but is delivered only to members of the Swedish Touring Club with the Yearbook for 1923, the two remaining parts being reserved for similar issue with the Yearbooks for 1924 and 1925. There are to be a number of city plans and a comprehensive index of names. The "touristic" point of view of course has governed the choice of names and points and the style of expression, but this takes nothing from the value of the map. The number of inhabitants at all town and village localities is indicated by the style of symbols used. Swedish tourists have an atlas of their country that no other country can match.

MARK JEFFERSON

AN ATLAS OF THE ECONOMIC GEOGRAPHY OF NORWAY

PER NISSEN. **ϕkonomisk-geografisk atlas over Norge med en oversigt over de kulturelle og ϕkonomiske forhold saerlig naeringsveiene.** [Atlas of the economic geography of Norway with a survey of cultural and economic conditions, especially with regard to commerce.] 66 pp. of text and 48 pls. of maps and graphs. H. Aschehoug & Co. (W. Nygaard), Christiania, 1921. 20 x 16 inches. 44.60 kroner.

This work, planned for issue in 1914, was to be a memorial of the centennial anniversary of the Norwegian nation and is of monumental proportions. It weighs 8 pounds in the paper board edition, measures 20 by 16 inches, has wide margins and heavy paper plates; and the text of ninety odd thousand words is printed in large, leaded type. Very likely as a memorial volume a big conspicuous one was wanted. Whether intended or not, this book exceeds considerably the dimensions of convenient use, which I think are set by the well-known Atlas de Finlande of 1897 and the Atlas of Canada of 1906—that is about 12 by 17½ inches.

The Norwegian atlas reminds one at once of these older works, though neither of them was a memorial volume. But each had a geographic cast lacking in this book, the one being edited by a committee of the Geographical Society of Finland, and the other by James White, geographer. There is a comparatively slight amount of material here gathered for publication. The Finnish atlas has 103 maps and 56 statistical graphs, the Canadian atlas 103 maps and 289 graphs, and the present work 36 maps and 36 graphs. The best work is in the text. The description of Norway presented is extremely interesting. As it is printed in Norwegian only, reference may be made to J. Poirot's good seven-page resumé of it in the *Annales de Géographie* (March 15, 1923). This atlas cannot, of course, attempt to supplant the admirable "Norway," published in the English language for the Paris exposition of 1900 by the Ecclesiastical and Educational Department of the Norwegian government, with 250,000 words of text and many excellent illustrations, and describing aspects of Norwegian culture that the "Atlas over Norge" does not touch upon.

All the maps are clear and the colors beautiful. It would be difficult anywhere to find a map clearer, more expressive, or more pleasing than that of fishing grounds and fish varieties in the waters between Norway and Greenland (1:8,000,000), "after Iversen." The double plate No. 15–16 is a fine map of Norwegian forestry (1:2,000,000), stated to be from Gleditsch's map of 1914 of four times larger scale. It distinguishes hardwoods, conifers, waste land, and tilled land. The orange tint chosen for the tilled land is admirable for symbolism, for harmony with the forest greens and abundant contrast to bring out plainly the little scattered patches of cultivation. I note, however, no tint on the fair-sized patch of tilled land at Loen at the head of the North Fiord, the only one I am well acquainted with in Norway. It is shown as occupied land on Figure 1 of half the scale. Norwegian writers make so much of the distinction of *furu* and *gran*, pine and spruce, that one wishes this map could have shown their distribution, or that another map could have been put in; but perhaps it is not practicable. The altitudinal succession of hardwood and conifers is well indicated.

The geologic map, (1:4,000,000,) is another good example of color work. So is the map of distribution of population; but it would be much more intelligible if it used shades of brown instead of the puzzling, if pleasing, rainbow tints that do not carry to the eye an impression of greater and lesser density. The density is expressed by spreading one tint over each county, which is of course unreal in Norway where waste land occurs everywhere; yet the counties are so small that good expression may be had here if shades of a single color are used. I find the occupied land, sketched in on Figure 1, the most satisfactory expression of human distribution for the case of Norway. It is of course impressionistic and subjective, but that is just what this special case seems to demand. A somewhat larger map on that plan was given as tailpiece to the "Norway" of 1900. The precipitation map (1:4,000,000) is of great interest, as well as the discussion of it. It is a pity that it limits itself to the isohyetals without the customary layer tinting that so much helps the eye to get that quick impression which such an atlas as this should offer. The five climatic maps that follow give a very inadequate presentation of the excellent work of Norwegian meteorologists.

It is a little surprising to find Figure 9 called Agriculture (*landbruk*); as it is merely a large (1:2,000,000) map of Norway with its provinces and the location of the agricultural schools. However, it serves to give the location of the data—tilled land, natural meadows, and tillable-but-untilled land—indicated in the graphs for each province on the same page.

Post offices, telegraphs, and telephones get mention in the text but no mapping. Railways and roads are well represented, and so are the fisheries so important to the country.

The volume is well worth its cost, but it fails to give an adequate account of the remarkable scientific achievements of Norwegian scholars which make this little country, in this as in most other aspects of culture, distinguished beyond what the meager number of its citizens might lead one to expect.

MARK JEFFERSON

AN ATLAS OF ITALIAN GEOGRAPHICAL TYPES

OLINTO MARINELLI. **L'Atlante dei tipi geografici de sunti dai rilievi al 25000 e al 50000.** 78 pls. with notations. Istituto Geogr. Militare, Florence, 1922. 28½ x 21½ inches.

This great atlas, published by the Military Geographical Institute at Florence on the fiftieth anniversary of its foundation, is truly a monumental work and reflects great credit on its compiler, Professor Olinto Marinelli. The first of its 78 sheets, all of which measure 26 by 37¾ inches, is occupied by an introductory text, from which it appears that the greater number of the topographic examples, selected from large-scale maps of Italy and her Italian possessions in Africa for reproduction as geographical types, are to be treated in accordance with the scheme of the erosion cycle; also that the object of the atlas is to serve as a basis of work by students and professors of geography in Italian universities, as well as to make the characteristic elements of Italian geography better known abroad. The second sheet contains a list of the headings under which the types are classed, an index map for their location, and a large table of conventional signs. Then follow 76 sheets of large and small excerpts from the maps, mostly printed in black, the relief being shown by contours on moderate slopes and by other conventions on steep slopes; seas, lakes, and large rivers are printed in light blue. A space of about six inches at the bottom of each sheet is reserved for explanatory text and a few references to special articles. Among the main topics are volcanic features, including young cones, dissected cones, lava tables and crater lakes; glacial features, including glaciers, glacial cirques and troughs, moraines and lakes; river meanders, free and incised, with a good variety of excellent examples; alluvial plains representing extinct lakes, two examples between the mountains inland from Pisa being of special interest; river mouths in remarkable variety, with elaborate large-scale illustrations from the delta of the Po; coasts of many unlike expressions; the drainage of coastal marshes, with a few inset maps of early dates to show the progress made since their publication; natural and artificial ports; roads (printed in red) in relation to centers of population, with some very striking illustrations of radiation from ancient towns on lowlands, also in relation to dikes and canals on the plain of the Po and on drained marshes, where rectilinear roads prevail, to various topographical features such as ridges, slopes, and valleys, and to ancient Roman colonies, where the roads still follow a rectangular system, manifest precursors of our land-section roads on the prairies and the plains; the distribution of isolated houses in certain districts, the linear and the compact groupings of various villages, and the great agglomerations in cities; boundaries of various kinds; and place names of different origins. The last sheet contains an index.

A rapid inspection of the atlas awakens interest; a close reading of text and maps is very informing; but a difficulty in handling the atlas arises from the unfortunate weakness of the paper on which the maps are printed. It may be questioned whether sheets of half the size would not have been more serviceable, even if some of the larger map excerpts had to be trimmed a little below their present expanse. By a curious misprint on inset C, Sheet 10, the north end of Lake Como is named Maggiore. One of the lessons that these well-chosen examples of actual geographical features teach is that, for purposes of instruction, they should be preceded by simple ideal types, from which the accidental irregularities and unessential complications of nature are omitted; for in many of the actual types distractions of these kinds abound. Moreover, in an ideal type, the significant features are clearly distinguished from their surroundings, but in the actual examples, surveyed without reference to their being types or not, there is often no sharp demarcation between the type forms and their irrelevant neighbors. Hence, to begin the study of land forms with this or any similar atlas would be like beginning the arithmetical basis of mathematics with a page from a bookkeeper's accounts instead of with the traditional three apples that Tommy had and two apples that Sally had; but to stop the study of land forms with simplified types instead of going on to actual forms such as Marinelli's atlas illustrates would be like stopping mathematics with mental arithmetic instead of advancing to the wonders of analytic geometry and the calculus.

W. M. Davis

A Detailed Study in the French Alps

Robert Perret. **Notice sur la carte au 20 000^e^ de la Vallée de Sales et du Cirque des Fonts (Alpes calcaires du Faucigny).** viii and 79 pp.; diagrs., ills. Henry Barrère, Paris, 1922. 11 x 9 inches.

Robert Perret. **Carte de la Vallée de Sales et du Cirque des Fonts (Alpes calcaires du Faucigny) à l'échelle du 20 000^e.** Henry Barrère, Paris, 1922. 11 x 9 inches.

The fortitude, enthusiasm, and skill of Robert Perret in his arduous task of detailed mapping in the French Alps compel our admiration. Simply for the joy of it, he undertook in the summers of 1911, 1912, and 1913, at his own expense, a minute instrumental survey of a small district, only 62 square kilometers in area, in the limestone mountains north of Chamonix. The work was done as continuously as possible while fair weather lasted, the nights being spent at the highest available shelter, with ascents to summits before sunrise, continuous observation and record at successive trigonometric stations through the long summer day, and descent to shelter after nightfall. After the interruption due to the World War the survey was completed in the summers of 1920 and 1921, when a total of 4000 points had been located, averaging 70 to a square kilometer.

The text which accompanies the map gives 20 pages to "Toponymie," or place names—a number of which have interesting etymological histories in these long-inhabited mountains. "Topometrie," or surveying, takes 26 pages; "Topologie," or local description, 22 more; and, after this, 6 pages are given to snow fields. The chapter on topology is of the greatest general interest: it gives a general account of the mountain structures and tells much of the work of erosion, "that chronic malady of mountains." In preparing this chapter the author, assuming like a true connoisseur much local knowledge on the part of his readers, begins his descriptions at a stage of knowledge about the Alps rather more advanced than that at which most American geographers leave off. But, just as expert collectors of engravings or coins or minerals rejoice together when one of their number displays his latest acquisition, so Alpinists everywhere will take delight in the results of Perret's work.

The map, printed in six colors on a scale of 1:20,000, is altogether exceptional in the degree of accuracy with which it portrays the minute forms of high mountains. There are few like it in the world; but it is insufficiently explained. The contours must be scanned to discover that their interval is 100 meters. Purple contours on purple stippling are shown in the legend to represent detrital slopes; but it is left to be inferred that blue contours on white ground represent snow patches, that green contours on white ground show upland pastures, and that green contours on a lighter green ground indicate forested slopes. The map is of that special kind in which contours are replaced by conventional rock signs for limestone, sandstone, and slate where steep-faced outcrops and cliffs occur; and, as a result, certain areas where great cliffs occur are not easily interpreted as to altitude; but, as this device was evidently adopted because contours would become confluent on such steep faces, it is presumably the best for its purpose.

W. M. Davis

The Problem of the Populating of America

Henry Vignaud. **Le problème du peuplement initial de l'Amérique et de l'origine ethnique de sa population indigène.** *Journ. Soc. des Américanistes de Paris*, Vol. 14 (N. S.), 1922, pp. 1–63.

The old question as to the origin of the American Indians is here reviewed by the distinguished French savant, the late Henry Vignaud. In a most entertaining way the reader is given a running sketch of the many fantastic hypotheses that have been advanced for their ancestry as, descendants of Noah, the lost tribes of Israel, of sailors from Solomon's fleets, of Phoenician sailors, of the Canaanites expelled by Joshua, of the Turanians of Asia Minor, the legend of Atlantis, of the Tatars, etc. With this as a historical setting to the inquiry, the author briefly enumerates the somatic characteristics, the linguistic traits, the main culture characters, and especially the obvious unity of the New World population. Then he turns to the geological and biological history of the New World, rejecting the hypothesis that the chronologies of the two are not synchronous, but accepting the view that the modern fauna originated in and reached its fullest development in the Old World. He then raises the question as to man: Shall we not expect him also to appear in the New World in his more primitive forms, but reach his highest development in the Old World? Rejecting the view that the aborigines were autochtonous, he accepts the view that they are Mongoloid. Regarding all mankind as either negroid, Mongoloid, or white, he assumes that in dispersal the negroid was first, then the Mongoloid, and finally, the white. The evidence for this is, however, not fully given.

Next the argument turns to the question of land connections or approximations, reviewing in the same manner the status of our knowledge and concluding that the only practicable routes, i. e. where the barriers were readily passable, were to be found in the Northern hemisphere, connecting with Asia on the west and with Europe on the east. Now the point to this discourse is that it was yellow Asiatics alone who migrated to the New World, but that they came from two directions and at different periods. Further, these migrations can be comprehended in a number of currents, or streams. For one thing, attention is called to the well-known fact that the long-headed tribes are massed on the eastern borders of the continent, while the roundheads are on the western side, which is usually explained as due to the fact that the longer heads came in from Asia first, followed by the roundheads; but our author proposes that the longheads came from Europe over the land bridges connecting with Greenland and Labrador. These he considers the most primitive, represented now by the Eskimo; they were followed by a second wave, the tribes of the Atlantic and of eastern South America. From the west, trans-Siberia, came later the round-headed tribes who occupy the highlands of both continents. These invasions, however, are regarded as having taken place a long time ago, and the cultures of the historic Indians were therefore in the main independent developments.

Unfortunately the author's discourse is too brief to cover the subject fully, but the reader will find it well worth perusal. In the main, the view is consistent with the present known facts, though many will be reluctant to accept the idea that part of the stream of Asiatic invasion came via northern Europe and across the Atlantic Yet this is not so improbable as it may seem, all hinging upon the date of the final submergence of the Arctic land bridge.

Clark Wissler

The Eskimo of Baffin Land

J. W. Bilby. **Among Unknown Eskimo: An Account of Twelve Years Intimate Relations with the Primitive Eskimo of Ice-Bound Baffin Land, with a Description of Their Ways of Living, Hunting Customs & Beliefs.** 280 pp.; map, ills., index. J. B. Lippincott Co., Philadelphia, 1923. $5.00. 9 x 6 inches.

The author of this book has attempted a very difficult task. He visited Baffin Land half a century after its inhabitants had materially altered their mode of life through contact with European and American whaling vessels, and when the "pure unmixed Eskimo stock" (p. 34), if it ever existed there, had yielded to a greatly diminished hybrid population. He has tried to brush aside these changes and to describe Eskimo life as it must have been 100 years ago, filling up the gaps in his own information from Boas' well-known memoir on the Central Eskimo. The amount of really new ethnological data is small, and there are many errors in the work due to an insufficient acquaintance with Eskimo literature. Geographers will be puzzled by the map, which shows three large lakes in the interior of Baffin Island besides the smaller Lake Mingo, whereas the latest official maps (e.g. Dominion Railway Map, 1920) show only two. Their description in the text (p. 51) is only a corrupted version of Dr. R. Bell's account (*Ann. Rept. Geol. Survey of Canada*, 1898, Part M, p. 14) and disagrees entirely with the author's map.

These shortcomings impair the scientific value of the book, but it still has a considerable popular value. It gives a clear and very readable picture of native life in the olden days, full of vivid descriptions and well-told narratives. The illustrations are excellent, and the publishers (save for a few typographical errors) have fulfilled their part to perfection. One may confidently recommend the book to a lay public that desires instructive entertainment and is not too critical in the matter of detailed accuracy.

D. Jenness

A Botanist's Visit to Greenland

A. C. Seward. **A Summer in Greenland.** xi and 100 pp.; maps, diagr., ills., index. The University Press, Cambridge, 1922. 7s. 8 x 5½ inches.

Greenland, the favorite foster child of Denmark, lies happily outside the range of the tourist and globe-trotter; those only may visit its shores who find favor in the eyes of its Director at Copenhagen. Were there no other reason, therefore, Professor Seward's brief account of his trip to Disco would be of more than passing interest. The author's main purpose has been to depict the strange beauty of this rugged coast during the long summer days, the fantastic shapes of the icebergs floating in the open sea, the scarred mountain sides that slowly shed their glaciers into the fiords, and the varied carpet of low flowering plants, mosses, and lichens that give a softness to the landscape during the brief period of their emergence from beneath the winter snow. Mingled with descriptions of the scenery are clear, untechnical accounts of the more fundamental geological and botanical features of the region, a comparison of arctic and tropical vegetation, and an outline of the evidence derived from fossil plants and shells of a subtropical climate in the Mesozoic era. Dr. Seward notices the unsanitary conditions of life under which many of the Eskimo inhabitants still live and the consequent prevalence of tuberculosis; but he was much impressed by their intelligence and self-reliance and clearly believes that the time is at hand when they should be given greater educational facilities and a larger share in the administration of the country. In this connection he pays a well-deserved tribute to the liberal and far-sighted policy of the Danish government.

The book is charmingly written but is all too brief. One wishes that Dr. Seward had been more generous in his discussion of the many problems with which he found himself confronted; for example, the distribution of land and sea in ancient times, the changes of climate, and the migrations of plants and animals. Even a layman may confess to an interest in such matters.

D. Jenness

Travels in the Western Marches of China

Eric Teichman. **Travels of a Consular Officer in North-West China.** xiii and 219 pp.; maps, ills., index. The University Press, Cambridge, 1921. 9½ x 6½ inches.

Eric Teichman. **Travels of a Consular Officer in Eastern Tibet, Together with a History of the Relations Between China, Tibet, and India.** xxiii and 248 pp.; maps, ills., index. The University Press, Cambridge, 1921. 9½ x 6½ inches.

The first of Mr. Teichman's two books is an account, essentially narrative, of journeys taken by him in the interest of the Anglo-Chinese Opium Treaty through the provinces of Shensi and Kansu in the early days of the Republic. The author is a good traveler, an intelligent observer, and an easy writer. Woven into his narrative are bits of Chinese character and politics, much of recent history, and a considerable amount of descriptive and human geography. The last two topics will be stressed in this review. A very valuable part of the book is the fine series of illustrations. Outline maps show the author's routes in Kansu and Shensi and the projected railroads toward and within these provinces.

Tungkwan, at the southern bend of the Hwang Ho as it swings around the southwest corner of Shansi, is described as a commercial point defended by the fortress instead of simply a garrison town as Richards indicates. This is because it is at a junction of the two great highways from Peking and Honan respectively, at a place where the great Yellow River can be conveniently crossed by boats, for there are no bridges. The great road then leads westward to Sianfu where it bifurcates, one branch reaching southwest to Chengtu and Tibet, the other northwest to Lanchow and Turkestan. Thus Tungkwan is a most important strategical point, has been such for ages, and will be in the future; railroads are sure to converge upon it, and railroad engineers usually find the great Chinese roads exceedingly well chosen. This city is admirably situated also for the levying of *likin*, because it is hemmed in by river and mountain and no commerce can avoid it. A peculiar four-wheeled vehicle of prehistoric appearance is used here: a style of wagon very rare in China, where one and two-wheeled transportation is the common type. The city streets and the road west to Sian are the only vicinal places where such a wagon could go. Sian is in the midst of an extensive cotton-growing area and would seem destined to become a great spinning and weaving center.

In similar illuminating manner are many little-known places set before us—for instance, Hinghsia and Paotow on the Hwang Ho, Hsingan on the Han 125–130 miles south of Sian, Lanchow, and Chenfan in Kansu.

The rice-wheat line between north and central or south China is located on both topographic and climatic foundations. This line, which is easily recognized on the Peking-Hankow railroad, Teichman describes as seen about 20–25 miles south of the big south bend in the Yellow River on the road crossing the pass in the Tsinling Shan at an altitude of 6000 feet. On the north side is the dry, dusty loess wheat land. On the south side are the much better watered, more deeply dissected rice lands with their myriads of water-covered terraces. And similarly rice lands are found many miles farther west at the altitude of 7600 feet, and again on the Sian-Chengtu highway practically along the Szechwan-Shensi border. In these parts the loess extends farther south, to the Ta-Pa-Shan, and likewise do the wheat fields; while south of this range, where the rainfall is considerably greater, rice paddies become very abundant and wheat ceases.

The author agrees fully with Willis and Blackwelder, though not in technical terms, that the country tributary to the Han south of Sian is in vigorous youth with its gorges, cliffs, and roads in stream beds or hanging on rugged valley walls and in its lack of continuous culture because so rough. He also points out that this rough belt of country did much to keep the Taiping Rebellion out of central and northern Shensi; it has also kept the Han valley to the south peaceable in recent years while brigandage raged in the Wei valley.

The northern half of Shensi is described as a loess plateau with deep valleys leading in the main southeastward. It is extremely difficult to cross from southwest to northeast but fairly easy to travel down the valleys. The author calls attention to the frequency of the paths on the loess ridges in an endeavor to correct the popular impression that most roads in the loess country are in travel-and-wind-made trenches. Water in the loess country is scarce and especially so on the ridges, but many of the streams in the narrow valleys are intermittent. Brigandage in much of this North Shensi country seems specially favored by the roughness of the topography and by the many hiding places in loess rifts and in caves hollowed out of the loess.

Teichman believes (p. 67) that the climate is becoming more arid in northern Shensi and northeastern Kansu, even now approaching desert conditions; but it seems to be a change covering only recent time, perhaps not more than 40–50 years. He thinks the treeless loess areas in Kansu are bare because of soil and climatic conditions and not because the Chinese have cleared them. He therefore takes no stock in the idea that the treeless condition is a cause of the aridity.

The high grassy steppes which border China proper on the north and west are described in some detail. In parts these high grasslands are over 10,000 feet in altitude and have the appearance of late mature to old erosion surfaces uncut by the streams in their present cycle, and this in spite of their great altitude. This interpretation is further supported by the fact that "one always ascends to them through a region of broken mountains, whether from Szechwan or Kansu up to the Tibetan Plateau or from Chihli, Shansi, Shensi, or Kansu to the highlands of Mongolia." These excellent pasture plateaus are the home of nomads and lama priests whether west or north. In past centuries the Chinese were ever defending their fertile fields against incursions from these table-lands; but now the nomads are impotent; and these vast, nearly empty spaces serve as buffers protecting China from the rest of Asia.

Epo is a wool market near the Kokonor-Hwang Ho divide. North and west desert conditions prevail. South and east more rain falls, hence rich grasslands spread everywhere at the general altitude of 9000–10,000 feet. Above the pastures overshadowing snow caps rise to an altitude of 18,000 feet, providing for abundant irrigation in the valleys below the grazing lands.

Many market towns near the upper Yellow River collect wool, musk, gold, furs, and hides. After these products have changed owners two or three times they fall into the hands of foreign dealers who get them to the coast largely free from *likin*, or local tax, by virtue of International Treaty right, the only duty being paid at the coast to the customs office.

The Chinese have adapted themselves and their agriculture very closely to the semiarid conditions of their great northwest. Irrigation is the only key to its agriculture. In many places they have planned and developed through the centuries marvelous systems of conserving and distributing the water. Great wheels are used in places to elevate the water from the stream to the level irrigable lands 40–50 feet above. Much more could probably be done below Ninghsia by modern engineering methods, but the present systems are a monument to the efficiency of the Chinese.

Enough has been said to give an idea of the material dealt with in this volume. To the geographer its main interest perhaps lies in the vista of problems opened up, for this land is one of the geographic frontiers where careful research will bring ample reward and where the love of adventure can be abundantly satisfied.

The book on Eastern Tibet begins with a historical setting—a statement of developments along the Indian-Tibetan and Sino-Tibetan frontiers for the hundred years leading up to the situation confronting the interested nations at the end of 1918.

Mr. Teichman's travels begin at Tachienlu in western Szechwan. This town marks the boundary between Chinese and Tibetans, just as Sining, west of Lanchow, marks that between Chinese and the Mohammedans of Kokonor grasslands and Kalgan, northwest of Peking, marks the contact of Chinese and Mongolian, though none of these towns are on the corresponding political boundary. The round trip led northwestward beyond the Kokonor boundary, thence south across the heads of the Mekong, down this river and a branch of the Salween, and thence northeastward across the Mekong and Yangtze to Batang and back to Tachienlu. Cross trips took him to many towns in this large loop. The entire expedition occupied almost a year and covered nearly 2700 miles. About three-fifths of the book tells of the details of the journey and recounts many interesting and thrilling experiences. The last 17 pages are devoted to general observations; and then come tables of altitudes, distances, temperatures, and weather notes—a valuable part of the work.

Only two places lower than Tachienlu (8500 feet) were visited; both were hamlets on the Mekong near Yenching at 7900 feet. Most elevations determined were from 10,000 to 16,000 feet above sea level. Of course many higher peaks and ranges were seen. This portion of Eastern Tibet is along the border of the great plateaus of Central Asia. Much of the plateau country seems to be of red sandstone with topography in advanced maturity, in parts approaching peneplanation, which has been elevated high above its own base level. The wave of rejuvenation induced by the uplift is already working up the streams and has reached southern Kham. The great rivers Salween, Mekong, Yangtze, and Yalung flow in deep canyons with falls and rapids in this part.

Numbers of valleys above the falls and rapids are broad, glaciated, much more mature, and as yet unaffected by the rejuvenation. These topographic differences make marked differences in the kind and ease of travel in the two sections. The so-called south, or Batang, road toward interior Tibet crosses, of necessity, alternate canyons and ridges with a relief of 8000 feet, while the north road is able to keep pretty well up and make the passes by easy gradients. In fact, the northern route might be made passable for carts without difficulty. Teichman's descriptions bring this out, and several of his photographs show the characteristic topography of each part.

In the northern section grasslands predominate and cultivation is quite rare, but in the south, gardens and fields of barley and wheat are common in the valleys, with grass on the high shoulders, remnants of the older topography. Neither of these pictures meets the popular conception of arid, wind-swept, scorching areas full of exhausting hardships for the traveler. But both are true. On the north slopes are often found heavy pine forests, with only juniper cover on bare south-facing slopes. Bright sunshine in rarefied air and lack of moisture are both suggested as causes for the lack of big pines. On the lofty peaks and ranges living glaciers are frequent. The permanent snow line is about 18,000 feet in Chamdo; but, as precipitation increases southward, it creeps to a much lower level in Burma and Yunnan.

Transportation, except human, is almost entirely by yak, mule, and pony in this country; the camel so much used in Kokonor is never seen here. Wild life is very abundant.

There is a curious mixture of racial types among these Eastern Tibetans: flat-faced Mongolian, tall, thin-faced "Aryan," curly-haired, almost negroid, and strong bearded Turkish types are mentioned. The land has been long inhabited and will be an attractive and probably difficult field for the ethnologist for a long time to come.

George D. Hubbard

The Paleogeography of South Africa

A. L. du Toit. **The Evolution of the South African Coastline.** Diagr. *South African Geogr. Journ.*, Vol. 5, 1922, pp. 5–13. Johannesburg.

Dr. du Toit's article, representing a lecture recently delivered before the South African Geographical Society, does not discuss the development of the South African coast line during one or more cycles of coastal evolution, as one might infer from the title, but deals almost entirely with certain widely separated positions of the shore line as determined largely by changes in the level of land or sea—events which interrupt normal shore-line evolution. It is an interesting study of the paleogeography of South Africa at different epochs from the Triassic down to the present.

Accepting the theory that a vast southern continent, Gondwanaland, was broken up into many remnants of which South Africa is one, the author starts his story when the primitive Indian Ocean was believed to be forming and thereby determining the main outlines of the African continent. The shore lines of the Lower Cretaceous, Upper Cretaceous, different periods of the Tertiary, and of the Pleistocene are traced with greater or less precision. One feature inland from the present shore which receives special attention is a platform traceable almost continuously for 350 miles and having a maximum breadth of 30 miles, beveling folded rocks, and attributed by the author to marine rather than to fluvial erosion. The platform is believed to have been carved during the first half of the Tertiary, and on its surface are deposits of considerable extent containing late Tertiary marine fossils. This is of special interest to American students of the supposed terraces of the New England upland, which have in part been attributed to marine erosion in Tertiary and later time but from almost all of which marine deposits and fossils, if ever present, must be assumed to have been completely removed by later erosion. The submerged Agulhas Bank is correlated with the continental shelves bordering other great land masses, and all are attributed largely to marine erosion during the ice age, their present supposed uniform depth of submergence being ascribed to the uniform rise of sea level consequent upon deglaciation. The mingling of cold and warm currents on the Agulhas Bank is said to have been very destructive of life, and deposits of shells and fish bones cemented by glauconite are apparently ascribed to this destructive agency. Large bays like False, Mossel, Plettenberg, and Algoa are considered to be the product of wave erosion in weak rocks.

It is clear that in a few brief pages Dr. du Toit touches on a number of problems of more than ordinary interest. Perhaps the nature of his address and the conditions under which it was delivered precluded the possibility of a fuller presentation of the evidence upon which his far-reaching conclusions were based; but one cannot help regretting that in its published form the article compels the reader to accept on faith, if he accepts at all, many of the author's most important statements. We are told with some detail just where the South African shore line ran millions of years ago but are told almost nothing of the evidence on which the location of that shore line is based. When one remembers that the present landward limit of a geological formation is no indication of the sea margin of its period and considers the great difficulty of locating ancient shore lines as well as the conflicting and oft-changing testimony of paleogeographic experts, one will understand why conclusions as to the position of ancient coast lines must be accompanied by an adequate statement of the nature of the evidence supporting the conclusions, if the latter are to gain wide acceptance. If the great continental shelves are largely the product of wave erosion during the glacial period, then not only our present conceptions of the rate of wave erosion and of the length of the ice age but certain other standard geologic and physiographic beliefs must radically be reconstructed. Hence the importance of setting forth the grounds for so novel a conclusion, in order that their validity may be tested and, if they are found valid, that the reconstruction of our theories may proceed upon a solid and enduring basis. In the absence of supporting evidence the average reader is apt to dismiss the explanation of False, Mossel, and other bays as a reappearance of the obsolete theory that deep embayments are usually to be explained by wave erosion on weak rock belts. But Dr. du Toit makes clear in the first part of his paper that he appreciates the importance of partial submergence of subaerially-formed lowlands as a common cause of bays; and he may have discovered valid evidence that the particular bays in question are not of this origin but are directly due to marine erosion. If such be the case, the conclusion is so significant that a statement of the evidence on which it is based seems most desirable; especially since the form of the bays as recorded by charts makes the wave-erosion theory seem of doubtful validity to one who studies the problem from a distance.

Douglas Johnson

Problems of the Norwegian Coastal Plain

Fridtjof Nansen. **The Strandflat and Isostasy.** viii and 313 pp.; maps, diagrs., ills., bibliogr. Jacob Dybwad, Christiania, 1922. 10½ x 7 inches.

This remarkable work is concerned with three problems. One is the description of the coast plain, or strandflat, as Nansen prefers to call it, of Norway and other high-latitude coasts. It is a moderately uneven surface, up to 50 or 60 kilometers in width, transecting all sorts of rocks, here and there surmounted by steep-sided residual eminences, and more often interrupted by fiords and bays; the summits of the minor unevennesses lie in a nearly horizontal surface, partly above, partly below sea level, abutting rather abruptly against the steep base of the inner highlands, and gently inclining seawards, so that as it dips under water it is resolved into a swarm of small rocky islands. The middle portion of the book, pages 55 to 164, is occupied with detailed and well illustrated accounts of the strandflat along the Norwegian coast, largely based on the author's own observations made during cruises in 1904, 1909, 1911, 1912, and 1913. The geographical traveler in Norway should have these accounts along with him as a guide to the study of a remarkable physiographic feature, of much significance in its human and economic relations. Accounts of the strandflats of Spitsbergen and other Arctic coasts follow, pages 165 to 216.

The origin of the strandflat is a second problem, which is treated in the first 54 pages on the basis of a summary description similar to that given above; and this arrangement is to be commended, because it enables the reader of the following descriptions to consider them in view of various theories of their origin. Nansen considers and rejects the views of certain Swedish observers who, with no sufficient evidence, explained the inequalities of the flat as the result of faulting; he rejects also the view of Ahlmann that the flat is wholly the product of subaerial erosion; and, modifying the view proposed by Reusch—to whom the work is dedicated, he explains the flat as the product of marine abrasion, largely aided by frost erosion, on the partly worn-down border of the Norwegian highland, chiefly in glacial time and especially after the deep glacial erosion of the fiords whereby the sea was given a greatly increased shore line on which to work.

The third problem of the book concerns the changes of level of the land during and after the production of the flat and the relation of these changes to the isostatic equilibrium of the earth's crust Although the uplift by which the Scandinavian highland gained its altitude probably in Tertiary time appears to be tacitly ascribed to deformational forces, the changes of level during the production of the strandflat are regarded as almost wholly isostatic, caused by the accumulation and the melting of the inland ice sheet in the glacial period and to a less degree by rock erosion. These changes in the altitude of the land are complicated by associated changes in the level of the sea, as water was withdrawn from it and returned to it in the making and melting of the ice sheet; and 130 meters (72 fathoms) is given as a minimum value for this sea-level change. The repeated return of the land mass to about the same altitude, after its depression by ice weight, is a striking feature in the evolution of the strandflat.

W. M. Davis

Climatology of the West Indian Waters and Bordering Lands

Wilhelm Kloster. **Bewolkungs-, Niederschlags- und Gewitterverhaltnisse der westindischen Gewasser und der angrenzenden Landmassen.** Maps, diagrs., bibliogr. *Aus dem Archiv der Deutschen Seewarte*, Vol. 40, 1922, No. 1, pp. 3–67.

A conspicuous gap in our knowledge of the cloudiness, rainfall, and thunderstorms of the West Indian waters and of the neighboring land areas has been filled by this monograph.

The limits of the district under discussion are, on the east, longitude 40° W.; on the south, the equator: on the north, the mean annual isotherm of 20° C. was taken as a general limit over the lands, while on the oceans observations as far north as latitude 30° were used. The material used includes everything available, much of it obtained from ships' logs and tabulated by "squares." All observations have been subjected to critical analysis, examination, and correction. Full tabulations, diagrams, maps, and a very complete bibliography are valuable elements in a monograph which is a worthy successor to the long line of outstanding meteorological discussions which have appeared in the *Archiv* of the Deutsche Seewarte.

The essential facts brought out by Dr. Kloster's investigation are as follows: The West Indian region lies in the zone of little cloud which extends roughly from latitude 10° to 35° N. Farther south the northern part of South America belongs in the equatorial belt of maximum cloudiness. The new data have somewhat changed our previous ideas regarding the size and position of the region within which occur months with less than 20 per cent of rain probability. The whole of the open ocean between latitudes 10° and 17° N., the Caribbean Sea, and the Gulf of Mexico are now included in this area. There are also changes in the rainfall districts. Köppen designated as a "district without marked periods of rainy days" a broad zone north of the Antilles. This is now to be considered as characterized by autumn rains. The summer rain province of Mexico, formerly limited by a line somewhat south of latitude 20° N., probably extends to the Pacific coast at latitude 15° N. Cloudiness in general has a similar annual variation to that of rainfall. This is also true of the diurnal period. There is throughout a very marked dependence upon the seasonal migrations of the wind systems. The thunderstorms also are closely correlated with these same conditions, the correspondence between thunderstorm occurrence and the districts of summer and autumn rainfall being marked.

The climatic facts are clearly presented for the four seasons and for the year and then summarized on charts showing the distribution of cloudiness, rainfall, and thunderstorms by districts according to their seasonal occurrence. A new chart of mean annual rainfall is given for the whole area, including the amounts over the ocean as well as over the lands.

R. De C. Ward

A Collection of Meteorological Essays

Napier Shaw. **The Air & Its Ways: The Rede Lecture (1921) in the University of Cambridge, With Other Contributions to Meteorology for Schools and Colleges.** xix and 237 pp.; maps, diagrs., ills., index. The University Press, Cambridge, 1923. 10½ x 7½ inches.

Sir Napier Shaw's successor as Director of the British Meteorological Office, Dr. George C. Simpson, recently emphasized the fact that meteorology had changed and was now less an observational study of the weather than a study, largely deductive and mainly mathematical, of the atmosphere as a whole. In other words, mathematicians and physicists and in a less degree chemists are beginning to find that there may be problems of both interest and profit in Atmospherics, using the term in its broad and proper sense and not in the limited sense of some recent English writers, namely, static electrical disturbances in connection with wireless. No man has done more than Sir Napier Shaw to treat the atmosphere as a tremendous thermal engine. After some forty years, off and on, of thought and trial he has brought this aspect into "the region of calculation" with an indicator diagram with temperature and entropy co-ordinates. It was Shaw, too, who gave us in his "Principia Atmospherica" the idea of a strophic balance, from which came the study and usage of geostrophic winds.

The present volume is, borrowing a phrase from Dr. Simpson, "full of new ideas and new views of old ideas." It is a collection of essays in which the author exercises his right to pass from climatology to physics and dynamics with an excursion of some length into agriculture, or rather the relation between weather and crops. He elaborates three new and ingenious principles, viz: (1) the motion of air under balanced forces, which is of course the state of affairs in the open; (2) the "eviction" of air by turbulence as an inevitable concomitant of convection; and (3) resilience of the air, to which is due effective stratification.

What will most interest geographers in the present volume is the series of maps, twenty-four plates in all, showing the distribution of certain meteorological elements over the northern and southern hemispheres. Sir Napier believes that maps are the most enchanting form of literature, and he would have every schoolboy own an atlas of his own at the age of ten.

The diagrams in the book are clear, and the half-tone cloud reproductions come out nicely. The typography of the book is excellent.

Alexander McAdie

The Climatic Sequence During and Since the Ice Age

C. E. P. Brooks. **The Evolution of Climate.** With a preface by G. C. Simpson. 173 pp.; bibliogrs., index. Benn Bros., Ltd., London, 1922. 8s., 6d. 8½ x 5½ inches.

No events in the earth's history have made a deeper impression on human thought or given rise to more speculation in regard to their causes than the ice ages, those great tragedies in the life of the earth's fauna and flora.

The continued interest in this subject is proved by the fact that in the past three years no less than five treatises of merit and originality have appeared offering radically different explanations of the ice ages. These are Humphreys' "Physics of the Air," 1920; Wegener's "Die Entstehung der Continente und Ozeane," 1920; Spitaler's "Das Klima des Eiszeitalters," 1921; Huntington and Visher's "Climatic Changes," 1922; and Brooks' "The Evolution of Climate," 1922. It is the last-named that is discussed here.

In Brooks' book the author begins by recounting many of the hypotheses which have been advanced to explain these catastrophes. These may be classified under the following heads:

(1) Variations in the amount of solar radiation.

(2) Variations in the amount of solar heat passing through the atmosphere of the

earth. (The solar radiation may be intercepted by dust in the atmosphere or by certain gases—such as carbon dioxide, ozone, or water vapor—which vary in amount.)

(3) Variations in the eccentricity of the earth's orbit and in the inclination of the earth's axis to the plane of the ecliptic.

(4) Variations in the latitude of places on the globe due to continental drift.

(5) Variations in the distribution and elevation of land surfaces on the globe.

To these might have been added at least two other possible variables, namely, (6) variations in the rate of the earth's rotation, due to the combined effect of the irregular shrinkage of the earth and the retardation from tidal friction, and (7) variations in the salinity of the oceans causing reversals in the surface currents between equator and pole. Variations in the speed of the earth's rotation would cause the water of the oceans to approach or recede from the pole, leaving larger land masses exposed. The continents might also respond slowly to such an influence. Variations in the salinity of the oceans might be caused by small rainfall with great evaporation in the equatorial regions at one epoch and large rainfall with small evaporation at another.

It is pointed out in various parts of the book that any acceptable explanation of the ice periods must meet the following conditions disclosed by the researches of geologists over the land surfaces of the globe. First, there have been several ice ages during geological time, separated by long intervals of milder climate. Second, these ice ages occurred simultaneously in Eurasia and America and in the northern and southern hemispheres. Third, at the time of the ice ages there was a great increase in precipitation in the equatorial region, but no great change in temperature. As a result of the great precipitation the glaciers on high tropical mountains increased greatly in extent and descended to near sea level before melting. Fourth, there was a great increase in precipitation in regions which are now arid, like central and southeastern Asia, the Sahara, the southwestern United States, northern Mexico, and central Australia. Fifth, the ice ages were not continuously cold, but there were pulses of great severity followed by milder intervals in which the ice partially or entirely disappeared. Sixth, the last ice age terminated between 10,000 and 20,000 years ago as is proved conclusively by the researches of De Geer in Europe and the wearing of the Niagara gorge in America. Seventh, the ice ages have been preceded or accompanied by great changes in the land surfaces of the globe.

In considering the various hypotheses, the author discards the hypothesis of solar variations as a cause of the ice ages, because in the case of solar variations the effects of these variations must be greater at the equator than at the poles, while the fall of temperature during the ice ages was at its maximum near the poles and least near the equator. "Moreover, there is not the slightest direct evidence in support of such a theory, and it can only be admitted when all other hypotheses have failed." My own researches in Argentina, much of which is still unpublished, have shown that small variations in solar radiation produce conditions over the earth's surface so similar to those described as conditions of the ice age that it is difficult to avoid the conclusion that an intensification of these variations might have produced an ice age.

The author discards the dust screen hypothesis as a cause of glaciation on the ground that, "It would require an enormous output of volcanic dust to reduce the temperature sufficiently: but in any case the relation, if any, between vulcanicity and temperature during the geological ages is rather the reverse of that supposed by Humphreys, periods of maximum volcanic action coinciding more frequently with high temperatures than with low." One wonders whether Mr. Brooks is sure of his facts in this case. It seems as if volcanic activity would be associated with the upheavals and changes in the land areas of the glacial epochs.

In regard to the hypothesis of variations in the amount of carbon dioxide in the atmosphere he says, "But it is now known that the terrestrial radiation which this gas is capable of absorbing is taken up equally readily by water vapor, of which there is always sufficient present, and variations of carbon dioxide cannot have any appreciable effect." Reasons for discarding this theory are more fully explained by Humphreys.

Croll's and Spitaler's hypotheses, based on astronomical conditions, are thrown out of court by the fact that the astronomical data indicate that the last ice age should have been about 80,000 years ago, while the geological data indicate that it terminated some 10,000 to 20,000 years ago.

In regard to Kreichgauer's and Wegener's theory of pole wandering he says, "In the first place, theories of this class demand that the glaciation occurred in different regions at widely different times, whereas we shall see in the following pages that the evidence points very strongly to a double glaciation during the Quaternary occurring simultaneously over the whole earth . . . Secondly, we know that the last phase of this glaciation, known as the Wisconsin stage in America and the Wurmian in Europe, was highly developed only 20,000 years ago and probably reached its maximum not more than 30,000 years ago. In the last 5000 years there have been no appreciable changes of latitude, at least in Eurasia, and it seems impossible for the extensive alterations required in the geography of the world by Wegener's theory to have taken place in so short a time."

In regard to the hypothesis of glaciation being due to changing land surfaces he says, "The geographical theory, which states that the Ice Age was brought about by elevation in high latitudes, and by changes in the land and sea distribution, though never seriously challenged, has suffered until recently from a lack of precision. The present author attempted to remedy this by a close mathematical study of the relation of temperature to land and sea distribution at the present day." The author then proceeds to present the results of his very interesting and painstaking studies of the influence of land masses and of water and ice surfaces on the temperature at different latitudes. These results lead to the conclusion that, given a sufficient increase in the extent and elevation of the land surfaces in high latitude, there would be a sufficient fall of temperature to account for the ice ages.

In explanation of the occurrence of the various ice ages and of the glacial epochs simultaneously in both hemispheres, he says, "The alternation of periods of crustal deformation with periods of quiescence has frequently been noticed and has been termed the 'geological rhythm.' It may be attributed to the gradual accumulation of small strains during a quiescent period until the breaking point is reached, when earth movements take place until equilibrium is restored, when the process is repeated." The world-wide simultaneous occurrence of crustal deformations suggests a cosmical origin, and the author thinks that the effective agency may be the slowing down of the earth's rotation under the influence of tidal friction.

Chapters III to XV are devoted to the history and description of the evidence of the ice ages and of the intervening milder climates in different regions of the world, including a story of the changes in animal and plant life and the attendant meteorological conditions. Although one may feel some disappointment in the author's reasons for abandoning some of the explanations of the ice ages, this part of the book is of the greatest interest; and students of the ice periods will find here a condensed statement of the literature of the subject written in a clear and attractive manner, with numerous references for those who wish to pursue the subject further.

In Chapters XVI and XVII the author gives the story of the climatic fluctuations since the glacial epoch based on investigations of peat bogs in Europe by Henry and others, of Alpine glaciers by Rabot and Brückner, of tree growth by Douglass, of past meteorological and geographical changes by Huntington, and of climatic changes made directly by himself.

Chapter XVIII treats very briefly of climatic influences in the development of man.

The book concludes with an appendix on the factors of temperature, giving a summary of his own investigations of the influence of land and water on temperature. This summary is all too brief and would be difficult of comprehension by persons who had not read the account of the original investigation published in the *Quarterly Journal of the Royal Meteorological Society* from which it is quoted. It would have been clearer had he reproduced the whole article.

H. H. Clayton

The Seas of the Dutch East Indies

S. P. L'Honore Naber and Others. **De Zeeen van Nederlandsch Oost-Indie.** ix and 506 pp.; maps, diagrs., ills., bibliogr., index. Kon. Nederl. Aardrijk. Genoot. E. J. Brill, Leiden, 1922. 11 x 7½ inches.

This noble work, published under the direction of the Dutch Geographical Society, is one of which any nation might well be proud. Its preparation was decided upon in 1915, and it has now been issued in celebration, a year in advance, of the fifty years of the Society's existence, 1873–1923. Eight authors have colloborated in its production. The history of exploration is treated by Naber (pp. 1–53); sounding and depths by G. F. Tydeman (pp. 55–124); temperature and composition by W. E. Ringer (pp. 125–177); maritime meteorology and tides by J. P. Van der Stok (pp. 178–212); biology by Max Weber (animals, pp. 213–249) and A. Weber-van Bosse (plants, pp. 250–271); geology by G. A. F. Molengraaff (pp. 272–357); and coasts by J. M. Phaff (pp. 358–494). A good table of contents precedes the text, but unfortunately the last chapter alone has an index, and no list of tables of maps is given.

Only a few items can be selected from the immense fund of material presented, for mention here. In Tydeman's chapter, the Sulu sea, with a temperature of 10.2°C. from a depth of 500 meters to the bottom at over 4500 meters, is still, as it was when its peculiar features were discovered by the *Challenger* nearly 50 years ago, the most striking example of a nearly enclosed marine basin, a small mediterranean. But not less remarkable than this and the other deep basins among the islands of the archipelago is the extraordinary foredeep, or long and narrow depression, off the eastern coast of the Philippines with a maximum depth of over 8500 meters. A similar foredeep but of less profundity is indicated parallel with and southwest of Sumatra and Java. The contrast of these great depressions with the smooth and shallow floors of the Sunda and south China seas—the Sunda platform—in the northwest, and of the Arafura sea—the Sahul platform—adjoining Australia is well brought out on a map, 1:10,000,000, reproduced from an atlas of the Dutch East and West Indies, on which increasing depths are indicated by eight shades of blue.

Molengraaff's chapter on geology, summarized and extended from his earlier essays, contains a great amount of geographical information. For example, he explains the contrasts of depths just mentioned as characterizing unstable and stable parts of the earth's crust. In the unstable areas, where deep seas and lofty islands alternate, a direct sympathy is found between the recent deformation of the crust in anticlinals and synclinals, and the form of the surface in arches above and in troughs below sea level. One of the most significant illustrations of this sympathy is found in the Tukang-Besi group of small islands, southeast of Celebes, where two anticlinal belts show elevated coral reefs, and two alternating synclinal belts show atolls. The distribution of coral reefs throughout the archipelago is finely shown on a special chart; all the islands which bear elevated reefs lie in the unstable area above noted. The opportunity for reef formation in that area is ascribed to diastrophic changes of island level; but in the stable area, where most of the reefs are fringes, their formation is associated with the post glacial rise of ocean level.

One of the most striking of Molengraaff's conclusions concerns the closely related fish fauna of the rivers of central northeastern Sumatra and of western Borneo, now separated by from 200 to 300 miles of the shallow Sunda sea. It is explained that during the glacial lowering of ocean level the shallow Sunda platform was laid bare; that the rivers of the two great islands were then extended towards each other until they became engrafted on a common trunk river which flowed northward to the somewhat greater depths of the southern China sea; and that while thus confluent the branch rivers acquired the community of fish fauna which they still retain since they have been betrunked by the post-glacial rise of ocean level. No better example can be found of the relation of physiographic changes to faunal distribution—a relation which ought always to be borne in mind by biological collectors.

Another conclusion of Molengraaff's is that the Sunda platform is a submerged peneplain, which was worn down on weak rocks to its present flatness during the lower stands of the ocean in the glacial period; but the extraordinary flatness of the platform, as revealed by innumerable soundings on large-scale charts, is much more suggestive of the equable distribution of fine sediments under the waves of a shallow sea during conditions like those of today than of erosion during epochs when the sea was absent. Erosion with respect to a lowered baselevel undoubtedly took place during those epochs, witness the minutely embayed island shore lines which Molengraaff cites southeast of the Malay Peninsula and west of Borneo; but as these islands consist of granites and other resistant rocks, it is doubtful whether all the erosion that their now submerged slopes have suffered could have been accomplished during the low-water stands of the glacial ocean. Some regional subsidence also may be invoked.

W. M. Davis

The Calendar and Its Reform

Alexander Philip. **The Calendar: Its History, Structure and Improvement.** xi and 104 pp.; bibliogr., index. The University Press, Cambridge, 1921. 9 x 5½ inches.

This discussion is at once compact and comprehensive, forming a useful textbook for reference and containing considerable material of general interest.

We find the basis of all measurement of time in the periodic movements of the earth, giving us the day and the year, and of the moon, giving us the month. A calendar is defined as "an attempt to establish fixed relations between the day, the month, and the year." The difficulties of calender construction arise from the fact that the year is not an exact multiple either of the day or of the month, nor the month an exact multiple of the day. Calendars have taken three forms: (1) solar, which give the year its true length and the month an arbitrary value; (2) lunar, which observe the true month and have an arbitrary year; and (3) lunisolar, which try to adjust the discrepancies between true month and true year by intercalations.

The ancient Greek and Jewish calendars illustrate the lunisolar type; while the Mohammedan calendar is the unique example of a purely lunar form, in which 12 lunations compose a year, and no attempt is made to maintain any constant relation between the months and seasons. The Julian and the present Gregorian calendars were derived from the early Latin calendar, a solar form. It is interesting to note that as early as the second century before Christ the Greek astronomer Hipparchus detected a slight excess in the generally accepted year length of 365¼ days. This accumulated excess, centuries later, led to the Gregorian reform of the Julian calendar. (On early calendars see also the article by Moses B. Cotsworth: The Evolution of Calendars and How to Improve Them, *Bull. Pan Amer. Union*, Vol. 54, 1922, pp. 543–570.)

With the introduction of the Jewish seven-day week the Julian calendar lost the great advantage of perpetuity. Apparently the Nordic peoples had a five-day week from which we derive the names of our week days, Tuesday to Saturday inclusive. The author points out that Saturday is not named for Saturn, as tradition runs, but may be derived, quite appropriately, from the Norse for bath day, or washing day.

The additional complexity occasioned by this new element in the calendar called for tables and almanacs to show the relation between the day of the week and the day of the month. Of particular difficulty were the calculations required to determine the date of Easter. The probable dates of the nativity (4 B.C.) and the crucifixion (April 7, 30 A.D.) are the subject of an interesting discussion. It appears that the use of the Christian era in dating did not become general till the eighth century or later.

In concluding, the author points out the chief defects of the present Gregorian calendar—the discord between month day and week day and the too diverse lengths of the half years, quarter years, and months. It is suggested that these defects may be most simply corrected as follows: Take one day from August and add it to the *following* February (to avoid disturbing the date of the vernal equinox). Exclude one day every year, and two days in leap year, from enumeration as days of the week, though they should remain in the monthly enumeration, and should occur at the end of a week, month, and quarter. Each quarter would then contain three months, 13 weeks, or 91 days, barring only the sequestrated day, or days. February 29 and May 31 might conveniently serve as the extra days. If this were done, the quarters and seasons would begin with the Sundays, December 1, March 1, June 1, and September 1, though January 1 might still be considered the beginning of the calendar year. Each week could then acquire an individuality by virtue of its fixed position in the year. By thus establishing a constant relation between the day of the month and the day of the week we should have eliminated the most troublesome fault of our present calendar without seriously disturbing our traditional methods of dating.

Eleanor S. Brooks

The Earliest Geographical Treatise

W. A. Heidel. **Anaximander's Book, the Earliest Known Geographical Treatise.** *Proc. Amer. Acad. of Arts and Sci.*, Vol. 56, 1921, No. 7, pp. 239–288.

Anaximander, one of the foremost Ionian thinkers and a pioneer in exact science, pupil or friend of Thales, lived, according to the computation of Apollodorus of Athens, from 611 to 547 B.C. Despite the fact that his speculations on astronomy and on the form of the earth—which he believed to be cylindrical, the upper circular surface being the habitable part—were fantastic, he will always be remembered for two things of primary importance in mathematical geography—for the invention of the gnomon, or primitive sundial, and for drawing the first map of the earth's surface.

The gnomon, according to Favorinus (who is quoted by Diogenes Laertius), was set up at Sparta. It was a perpendicular staff or column, the length of whose shadow, corresponding with the course of the sun, could be marked off on the ground in feet. It could determine the solstices and equinoxes and was of the greatest importance in early astronomical and geographical science, since for ages, in fact down to the time of the great Alexandrine astronomer-geographer Eratosthenes of the third century before Christ, when the sphericity of the earth was fully worked out, it was the only instrument known to the Greeks for determining terrestrial latitudes. While late writers—Diogenes Laertius, Suidas, Eusebius—attribute its invention to Anaximander, Herodotus, who wrote a century after the latter's death, says it was long before known to the Babylonians. Probably, therefore, the Ionian scientist merely introduced it to the Greek world; in any case, he was one of the earliest known Greeks to make scientific use of the instrument in cosmology, astronomy, and geography.

Still more important was Anaximander's map, an invention ascribed to him by Eratosthenes (quoted by Strabo), Diogenes Laertius, and Agathemerus. How difficult a task it was in those early days to make such a map is disclosed by the meager knowledge of geography so far attained. Without doubt the tablet mentioned by Herodotus in his account of the Ionian revolt in 500 B.C. (Bk. V, Ch. 49) was an adaptation of Anaximander's map, which, as we learn from the third-century geographer Agathemerus, was refined by Hecataeus, the renowned geographer of the generation following Anaximander.

The importance of Anaximander's inventions and of his book "On Nature" for the beginnings of geographical knowledge among the Greeks is, then, excuse enough for the critical and exhaustive study of Professor Heidel. It may be said that between the covers of this little brochure of fifty pages, so packed with information and reasonable inference, everything has been said that can throw any light on the achievements of this early Greek scientist.

Dr. Heidel's work is divided into three sections. Part I, containing half of the whole work (pp. 240–266), is largely concerned with a discussion of Anaximander's lost book "On Nature." Dr. Heidel concludes that such a treatise was current in antiquity and was regarded as a genuine work of Anaximander. He believes that the titles of various books attributed to the philosopher-scientist by the lexicographer Suidas—"Tour of the Earth," "On the Fixed Stars," "Sphere," and "*some other treatises*" not further specified—were, like the title "On Nature," late in origin, and "quite possibly at least in part" (p. 252) subtitles of the latter, thus indicating its wide scope.

The map of the earth is first attributed to Anaximander by Diogenes Laertius, of the first century before Christ, in his handbook on the "Lives . . . of the Philosophers", but through what intermediaries we cannot say. His testimony is supported by the geographical tradition, especially by statements found in Strabo, who lived in the time of Augustus, and in Agathemerus. Strabo, in two passages, quotes the geographer Eratosthenes, the famous Alexandrine librarian, as presenting Anaximander as a geographer; in the second passage he says that Anaximander made such a map, and he also adds that in his day a geographical treatise was attributed to the same scientist, which, however, he does not consider sufficiently authenticated. Agathemerus also records that Anaximander was the first "to venture to depict the inhabited earth on a tablet."

Part II (pp. 266–278) is chiefly concerned with the philosophical content of Anaximander's book—the origin, history, and future of the cosmos and its contents. Certain natural phenomena were explained in the book, *e.g.* the obliquity of the zodiac, eclipses, nature of the heavenly bodies, origin of the sea and its saltness, meteorological phenomena, etc. Here Anaximander's treatment was probably chronological and historical in character.

In Part III (pp. 278–288) the author discusses the sources of information about the early Milesian thinkers which lie outside the "doxographic" or philosophical tradition. Since this tradition is derived immediately from Theophrastus, the pupil of Aristotle, and therefore is Aristotelian in origin, we must get behind Aristotle and, wherever possible, check his account by information from other sources than the *doxographi*.

In conclusion (pp. 287–288) Professor Heidel attempts to frame a picture of this little-known but all-important work, "On Nature." He believes that its spirit was historical, since it sketched the life story of the cosmos, and that its exposition was chronological, as it discussed the origin of the world and the earth and life, the evolution of species, and especially the evolution of man and his works. Heroic genealogies seem to have joined the interval elapsing between the beginnings of man and the disposition of peoples and habitats in the time of Anaximander. At that point also were doubtless introduced the explanations of natural phenomena. Unfortunately such a book would soon become antiquated, although the later schools of philosophy and geography would always be interested in it.

Dr. Heidel's work is remarkably free from typographical and other errors. Despite the fact that the style at times is over-condensed and labored and even involved and that it is marred here and there by certain mannerisms, on the whole nothing but praise can be given to his attempt to reconstruct the contents of what is "for us at once the earliest known prose treatise and the earliest known literary document, whether in verse or prose" (p. 285) of Ionian science. It is only unfortunate that the ancient records of so important a book are so meager and so grudging—since from its impetus may be traced so many traditions, "growing in volume and progressively differentiating themselves" (p. 286), until they finally develop separate and distinct sciences—cosmogony, scientific medicine, geography, history, and metaphysics.

Walter Woodburn Hyde

An Eighteenth Century Scientist on Egypt

A. Lacroix and G. Daressy. **Dolomieu en Égypte (30 Juin 1798–10 Mars 1799).** viii and 140 pp.; map. *Mémoires Présentés à l'Inst. d'Égypte,* Vol. 3, 1922, Cairo

Among the distinguished company of scientists associated with Napoleon Bonaparte's Egyptian expedition (1798–1799) was the famous professor of geology at the École des Mines, Déodat Dolomieu, whose name is perpetuated in the mineral *dolomite* and in the Dolomite Mountains. Some of the lectures delivered by the geologist before the Institute of Egypt (formed at the time under Bonaparte's auspices) and certain of his notes are here published for the first time.

Dolomieu was a close observer and exact thinker. His notes on Alexandria contain a wealth of observations on the topography and antiquities of the city and on changes which had taken place in the past. A lecture on the causes of the destruction of the architectural monuments of Egypt ascribes their disintegration to the mechanical effects of rapid alternations of extreme heat and cold, and extreme dryness and damp (from dew), rather than to chemical decomposition.

More significant from the geographical point of view was a long discourse on the agriculture of the Nile delta, which, though written over a century ago, may well stand comparison with some of the best essays in human geography of the modern French school. Dolomieu notes two distinct agricultural regions comprising the delta north and south of a line from Rahmaniah to Mansurah. In the northern region the land stands at a generally lower elevation above the river channels than in the southern. Irrigation, hence, was more feasible. In the southern region the relatively higher level rendered irrigation difficult. Though inundated at the time of the flood, most of this land became parched with drought throughout the remainder of the year. The principal crops of the northern district were rice and sugar cane; of the southern, wheat, barley, clover, beans, flax, and indigo. With the exception of flax these are all important at the present time as well; on the other hand, cotton and corn (maize) have assumed the foremost place.

Having explained concisely the determining physiographic elements in Nile delta agriculture, Dolomieu goes on to discuss the technique of cultivation of various crops, the systems of land tenure, and the economic status of the fellahin. He warns against the preposterously exaggerated estimates current in his time of the fertility of the Nile valley and against a widespread belief that agriculture in that country required little or no work. His comments on the extreme conservatism of the fellah have been substantiated by more recent writers.

The nineteenth century has brought many changes in Egyptian husbandry: new crops, new markets, new methods of irrigation and cultivation. Dolomieu's account is of particular value as a dispassionate and scientific picture of conditions before Western influences began to be felt.

TRAVELS IN NORTH AMERICA AND EUROPE A CENTURY AGO

J. L. MESICK. **The English Traveller in America, 1785–1835.** viii and 370 pp.; bibliogr., index. (Columbia University Studies in English and Comparative Literature.) Columbia University Press, New York, 1922. 8 x 5½ inches.

S. R. ROGET, edit. **Travel in the Two Last Centuries of Three Generations.** 254 pp.; ills., index. T. Fisher Unwin, Ltd., London, 1921. 9 x 6 inches.

From books of travel, "Journals," "Impressions," "Notes," "Sketches," "Personal Narratives," and the like, some penetrating, some superficial, Miss Mesick has drawn together a multitude of observations on various phases of American life and character during the formative period of the United States. The United States was by no means neglected by the ubiquitous English tourist even in the early years of the last century, and especially during the second and third decades many adventurous wanderers crossed the Atlantic.

Among the many motives which induced Englishmen to visit this country, two were foremost: the desire to find a home with fresh opportunities in the New World and the love of travel for pleasure.

In general the British tourists did not wander from the beaten track. They stopped in the principal cities of the East, they looked upon Niagara Falls, a few ventured beyond the Appalachians or as far as New Orleans; but on the whole they kept clear of those wilder tracts where the difficulties of travel were severe. Rarely or never did they enter the country beyond the Mississippi or the great wilderness between the Ohio valley and the Gulf of Mexico, and even northern New England was avoided. Their narratives give many a vivid picture of the modes of American travel: the hardships of journeys over rough roads (often of corduroy in the backwoods) in none-too-comfortable stagecoaches, the comparatively palatial accommodations of the early river steamboats, the easy-going democracy and abundant fare of the inns.

In this connection attention is directed to the readable book edited by S. R. Roget. This volume, with its attractive illustrations, includes excerpts from the diaries and letters of Mr. Roget's forbears recording incidents of travel in western Europe between 1779 and 1872 and a journey in the United States in 1818. The passages, which were originally written without thought of publication, contain no very profound observations. Their value lies in the intimate details they provide of personal experiences on journeys made under circumstances widely different from those which prevail at the present day.

STRATEGIC GEOGRAPHY OF THE BRITISH EMPIRE

VAUGHAN CORNISH. **A Geography of Imperial Defence.** xii and 154 pp.; maps, index. Sifton, Praed & Co., Ltd., London, 1922. 9 x 6 inches.

Designed as a text for army promotion examinations, this book is calculated to appeal to British civilians generally as well as to military officers, for Imperial defence "is eminently a citizen's subject." Therefore it is written in nontechnical language, and the simplest geographic concepts are carefully stated.

With rapid brush the first chapter sketches leading facts and forces of distribution of population, agriculture, mining, manufacturing, and transportation. Inevitably the attempt to compress the outlines of world geography into thirty-five pages entails statements so broad that their implications tend to be ambiguous or inaccurate. The second chapter is described as "an account of the development and constitution of the British Empire," inserted because British captains must face an examination which includes this topic along with Imperial Military Geography. It has no other justification for its inclusion, and its title, "National Geography of the British Empire," is misleading.

The remaining half of the book deals with the strategic geography of the British Empire. The sections treating of oversea areas are rather sketchy, and at several points the reader is left with assertions of geographic weakness or strength that is neither obvious nor supported by demonstration: e. g. it is not self-evident that the Falkland Isles and Fiji are of equal importance to British strategy with Gibraltar, Malta, Aden, and Singapore; and the threat to British power of French Somaliland and St. Pierre and Miquelon needs more than asseveration to command acceptance. On the other hand, the pages on the defence of Great

Britain constitute a closely reasoned and cogent geographic argument which leads to a compelling and startling conclusion. This section is the prime contribution of the book.

There are two or three brief and useful expositions scattered through the study, incidental to the main themes. Although not new, hitherto the subjects they cover have not been stated so simply. One such is the environmental setting of Islam in India. Another is a survey of the political geography of Russia which amplifies that of Fairgrieve in his "Geography and World Power." A third is a statement of the relations of land and ocean trade routes.

It is to be hoped that the writer will one day give us a study of the strategy of the British Empire as valuable as his discussion in this volume of the strategy of the British Island.

D. S. Whittlesey

Narrative of a Voyage in the Eastern Pacific

W. H. Hobbs. **Cruises Along By-ways of the Pacific.** 162 pp.; maps, diagrs., ills. The Stratford Co., Boston, 1923. $2.50. 7½ x 5 inches.

Professor Hobbs recently undertook a voyage to the island arcs between Japan and the East Indies in order to study the tectonic relations of the atoll-raised-reef-volcano complex in a region of active mountain building. This volume, a part of the contents of which appeared in *Current History*, is a personal narrative of the journey. It is an entertaining account of the aspect of some inaccessible but important places and explains for the layman the objects of the cruise. The author had most unusual facilities for study in the Bonin and Volcano Islands and the Marianne, Caroline, and Pelew festoons, visiting Yap, seeing the Fey Islands and the little-known islands of the Western Pelews (North and South Sonsoral, Warren Hastings, Current, and Lord North Islands). This was rendered possible through a courteous and generous co-operation of the Japanese and United States naval authorities. From the Pelews the journey proceeded via Manila, Malampaya Sound, and Macassar, through Sape Strait into the Indian Ocean, thence through Sunda Strait to Tandjong Priok and to Singapore, the projected investigation of the Nicobar and Andaman Islands being abandoned owing to the recall of the mine sweeper Bittern to Cavite.

Professor Hobbs makes interesting remarks on the survey of the Carolines, Mariannes, and Pelews, and of their rapid improvement by the Japanese. He describes the flourishing conditions of these islands under the Japanese mandate and gives an important account of the growing commercial activity of Macassar. His technical results, which are of great interest to students of the geology of the Pacific, are now in course of publication (e.g. *Annales de Géographie*, Vol. 23, 1922, pp. 485–495).

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